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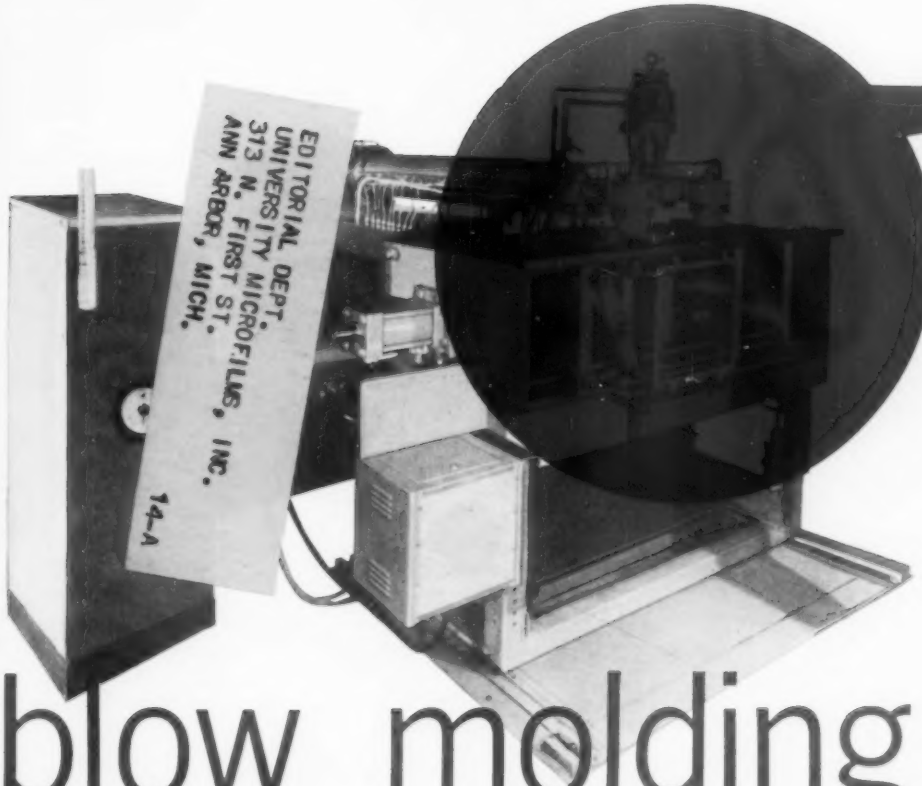
SPE JOURNAL

The Official Publication of the Society of Plastics Engineers, Inc.



blow molding

Technical information on blow molding with—

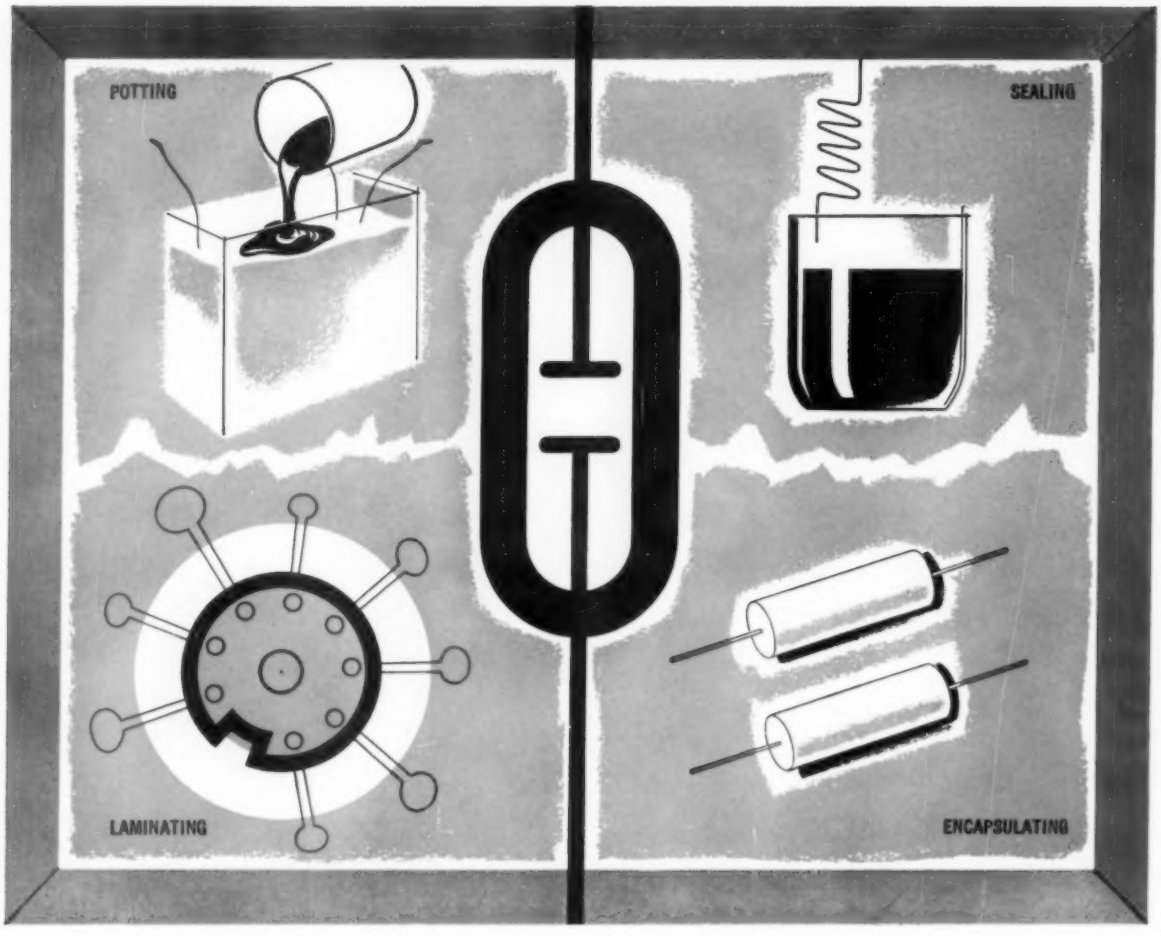
- HIGH DENSITY POLYETHYLENE . . . . page 609
- CELLULOSIC PLASTICS . . . . . page 633

Where to get the equipment—

- EQUIPMENT DIRECTORY . . . . . page 625

Some of the products for which blow molding opens up new design possibilities

- Plastic bottles
- Toys
- Industrial structures
- Auto gasoline tanks
- Auto glove compartment boxes
- Freezer compartments
- Gear housings
- Air conditioner housings



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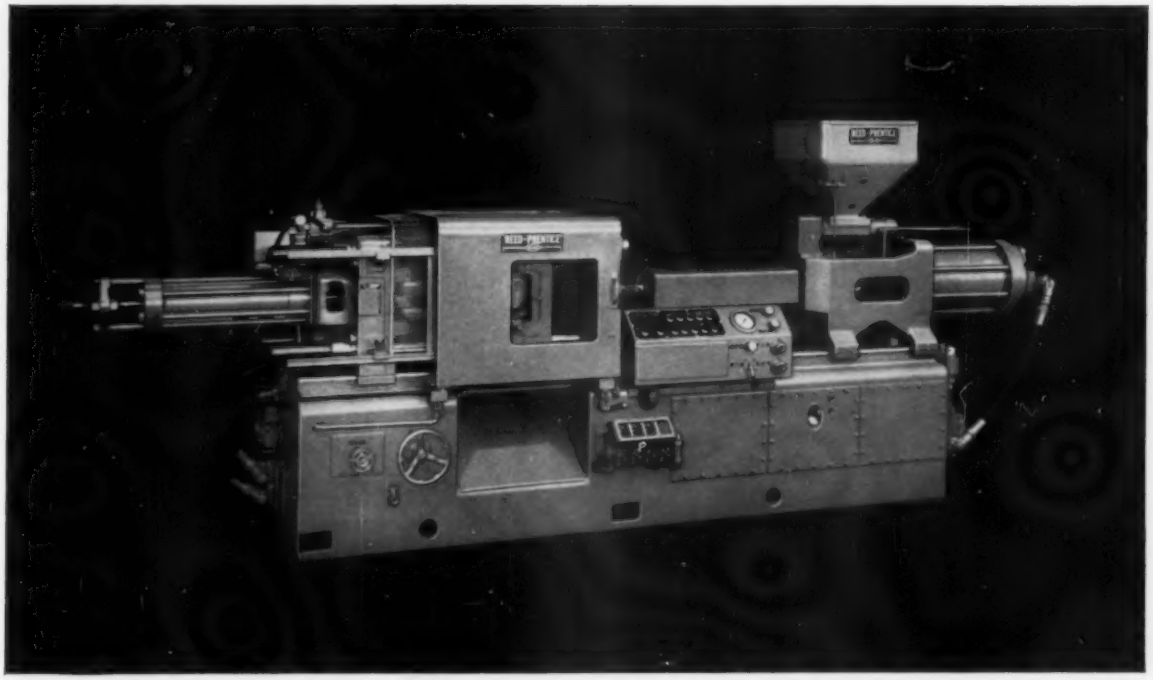

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Mold clamping stroke (adjustable)	6¼ to 11½"
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Diameter of Tie Bars	3½"
Space between tie bars	15½ x 15½"
Plasticizing Capacity (lbs. per hour)	120
Cycles per hour (maximum)	470

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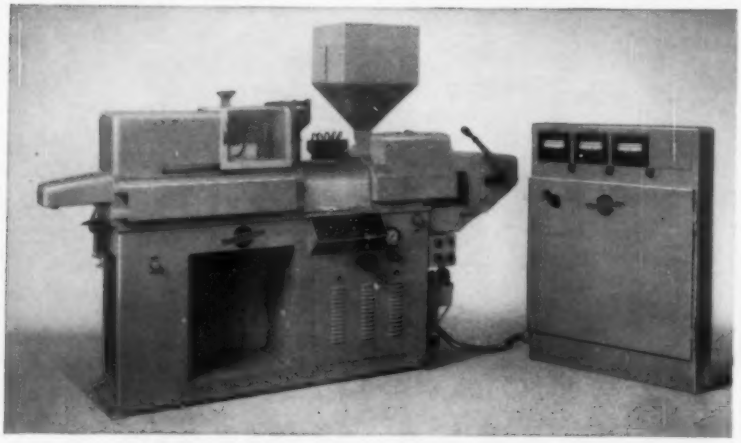

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The Cover

This month's cover shows technical progress in several areas of blow molding reported in this issue of The SPE Journal.

FOR
DEPENDABILITY
PERFORMANCE
PRICE & DESIGN

YOU CAN'T BEAT AN H-P-M

These Molders Tell Why....

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George Kelly, Gen. Supt. Columbus Plastics Products, Inc. "Downtime is negligible on our H-P-Ms. On our new H-P-M 6 oz. machines, maintenance costs per year were 1/5 that of other machines we have."

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E. Ostrowsky, Plant Mgr. and Chief Engr., Federal Tool Corp. "Our H-P-M preplasticizers give us top performance as to speed of fill, overall cycle and overall quality."

PRICE

John Fontenelli, Vice Pres. and General Mgr. Fibro Corp. "H-P-Ms are priced right. The reason we buy them is we get more machine for our dollar."

DESIGN

M. "Slim" Krajcik, Plastics Supt., Rubbermaid, Inc. "H-P-M's Preplasticizer is a well designed machine. I feel it's the machine of the future. We mold three cans on ours in the same time it took to mold two on another make machine."

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HPM

H4

Grueling use-test pits monomeric vs. polymeric plasticizers

Some years ago a vinyl upholstery manufacturer decided to field-test new materials for truck and transportation upholstery using a wide variety of monomeric and polymeric plasticizers, including Plastolein 9720. To compare *permanence* and *durability*, the different materials were installed on city bus drivers' seats. Here, seat upholstering would certainly be exposed to extraordinary abuse almost around the clock . . . continuous rubbing and flexing, city grime and grit, oil and grease.

After a certain period of time, all the upholstery containing monomeric plasticizers had failed. But all those made with polymerics, including Plastolein 9720, were still in excellent shape. With this evidence, the manufacturer concluded that only a polymeric plasticizer would meet its standards for truck and transportation upholstering, and protect its reputation. And Plastolein 9720 was chosen on the basis that it was the *lowest cost of all the fine polymerics tested.*

Today, Plastolein 9720 is *still* the lowest cost ploymeric plasticizer, and is *still* being used by this and many other manufacturers in such heavy-duty goods. Why not check 9720 yourself? Write Dept. J-6 for literature and sample.

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SPE JOURNAL NEWSLETTER

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1 minute

American Plastics Institute

The plastics industry may soon have its own institute—The Plastics Institute of America (PIA). A committee whose members have been drawn from all parts of the industry now has a complete proposal for such an Institute. This summer, the committee will ask industry for expressions of support. The Plastics Institute is expected to supply a flow of talent to industry, presently lacking, and much needed. SPE is sponsoring the committee until the project gets off the ground.

Colored Roads

Colored roads and curbs are now practical for the first time. Reason: A paving material made of plastics and aggregate. Plastics used are polypropylene, polyethylene, and polyisobutylene. Type of plastic used depends upon the precise application and specifications. Some applications: Airports, highways, swimming pools, and tennis courts.

More Expensive Molds

There is a well-established trend of plastics making inroads on some of the markets dominated by metals. But there is another trend which is not so well-recognized—yet. It is that the plastic materials that are taking the place of metals have to be molded to such close tolerances, that in many cases, the cost of building the molds becomes prohibitive (page 607).

Expansion of Urethane Capacity

Nopco Chemical Co. moves into the isocyanate field. The company's new plant, to be ready by January 1962, will have a capacity of 10 million pounds and will be expandable to 20 million pounds. Isocyanates produced at the plant will be used in the manufacture of urethane foams.

Blow-Molded Detergent Containers

Look for the detergent-container market to give blow-molders the biggest market breakthrough yet. The industry used over 500 million containers last year and it's fast growing. The groundwork is being laid with an SPI Committee actively developing standards for plastic container finishes. One prospect likely, the result of the blow-molding-detergent kinship: Construction of "satellite" plants by established blow molders in close proximity to the manufacturing or filling sites.

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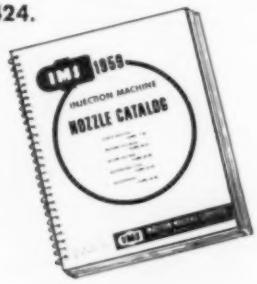

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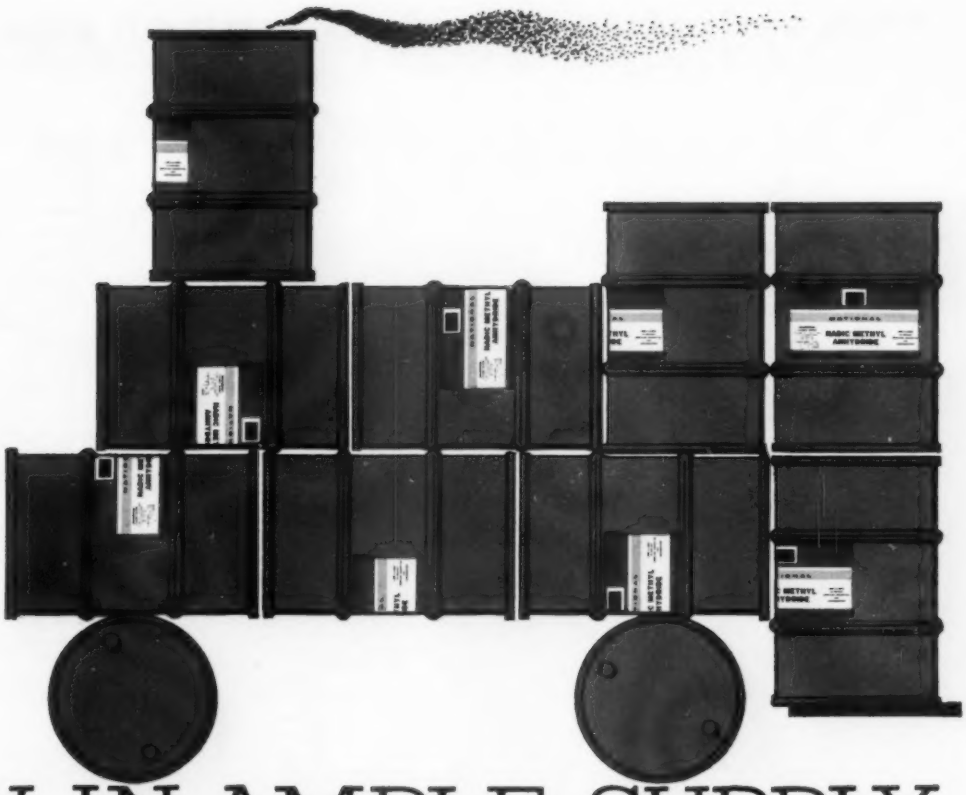

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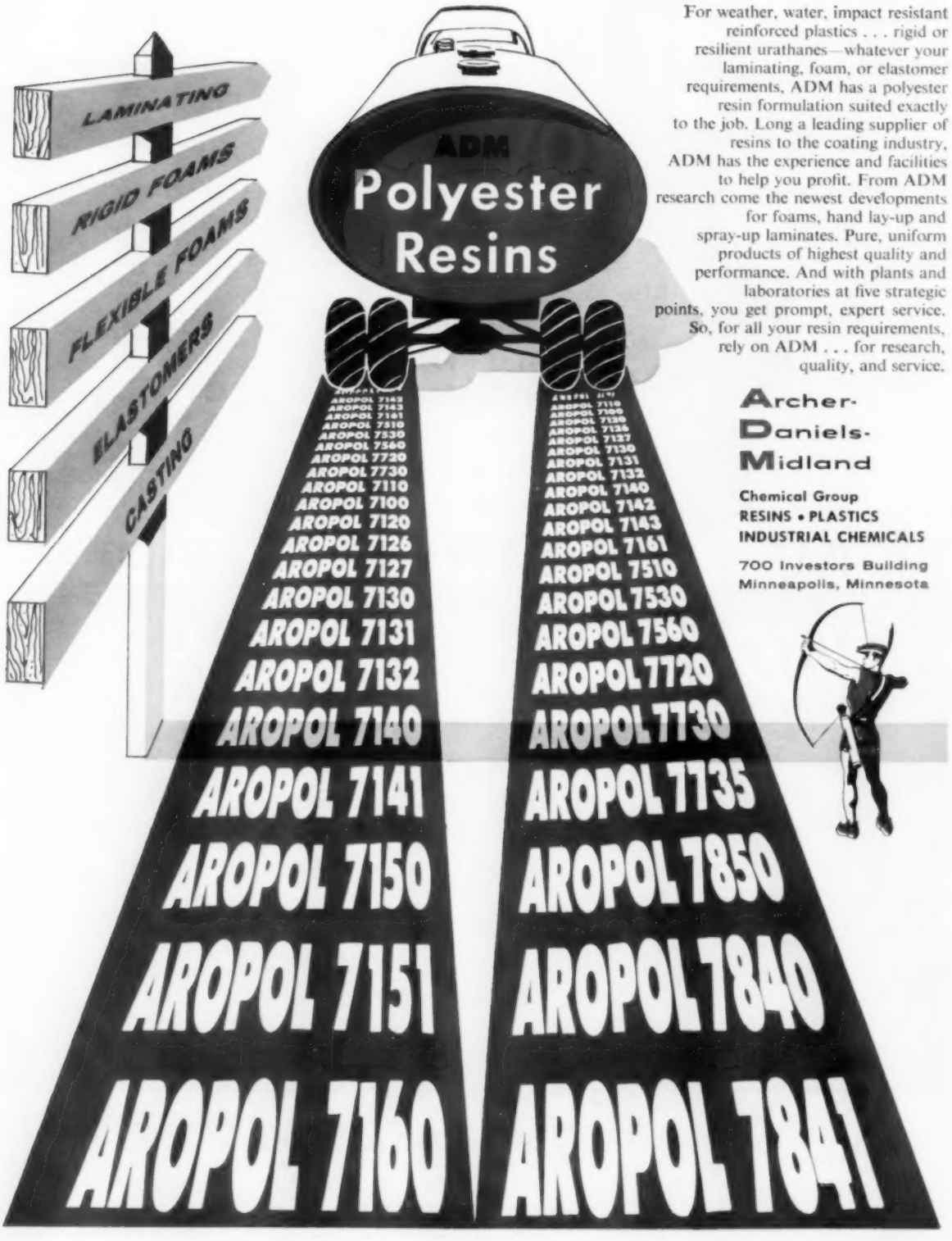

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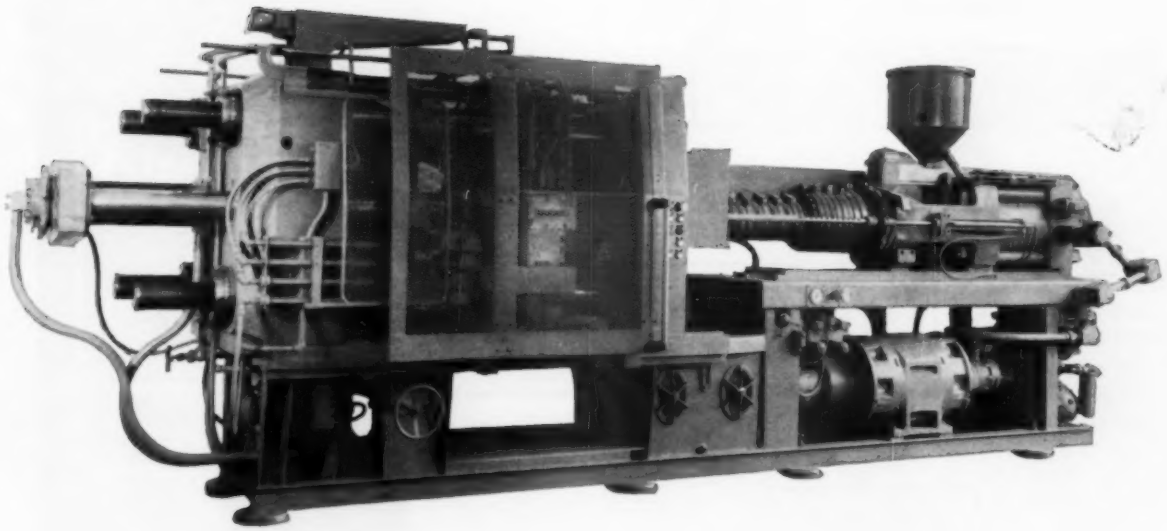

Impco Model HA16–425

20 ounce injection molding machine

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EDITORIAL

ABC Audit

ABC stands for Audit Bureau of Circulations. Key word in the ABC insigne is "paid". This means that publications, such as the SPE Journal, who earn the right (and must **keep** earning it) to display the ABC seal on their mastheads, must have all-paid circulations. Mr. James H. Moore, Jr., President of Moore Publishing Co., Inc., publishers of LP-GAS, stated it more simply in that magazine several months ago: "It means that a publication is being sent to someone who thinks highly enough of its value to want it regularly, and he makes that clear by going to the trouble and expense of paying for it."

Beyond the fact that ABC regularly verifies our reader audience, it means, also, that the SPE Journal is better able to serve its readers. Here's how. ABC makes a thorough business analysis of total paid circulation. To do this ABC requires complete classification of readers' company businesses as well as individual job functions. With this information, therefore, we are better able to plan and arrange balanced editorial coverage. We can pinpoint interest. Another important factor in ABC audit: In a fast-moving industry such as plastics, our audit helps us keep a close watch on growth trends.

Quoting Mr. Moore again—"ABC is the best assurance a subscriber has that the publication is edited first for his interest, and ABC is the best assurance an advertiser has that the publication is paid for and wanted."

"SYMBOL OF PROFESSIONAL EMINENCE"

Today, plastics engineers face greater challenges and opportunities than ever before. Technical complications arising from new materials and processes—automation, electronics and space age applications—are continually broadening their horizons.

More than 8000 of today's professional plastics engineers are members of the Society of Plastics Engineers, Inc., a non-profit, scientific and educational organization. Through their Society's publications and meetings, members are kept *up to date* on technical developments, trends and new opportunities. Their knowledge and prestige are broadened by associating directly with other members who work in polymer research, in development of new plastics materials, plastics products, machinery and equipment. Although heavily concentrated in the plastics industry itself, companies represented by SPE members cross all industry lines using plastics products, including aircraft and missiles, automotive, electronic, electrical, appliances, boats, building, furniture, textiles and packaging.

The challenges imposed on the plastics industry enable SPE members in executive, engineering or production capacities to advance both themselves and the plastics industry. This is why the SPE emblem is recognized as a "Symbol of Professional Eminence."

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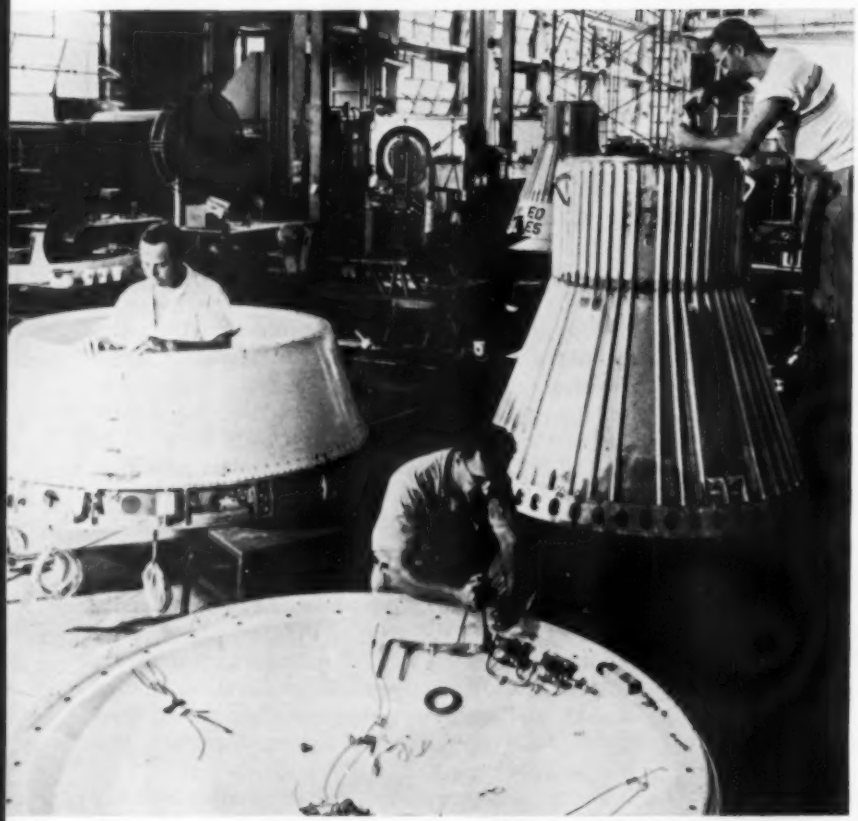

MORE ABOUT UNCLE'S MONKEY

Uncle Sam's first astronaut was a rhesus monkey, also named Sam, who took a 55-mile-high ride in a vehicle called Little Joe. It is Little Joe we're concerned with.

Specifically, with the part of Little Joe made from heat-resistant Hetron® polyester resin.

The full-scale Little Joe capsule is 9½ feet tall, 20 inches across the top and 6 feet across the rounded base. The bottom portion of this capsule consists of a heat-absorbing shield of glass-reinforced Hetron. Its several layers add up to an inch of thickness.

Hetron was chosen after intensive research because it provides an unusually high degree of inherent heat resistance, heat stability and fire resistance. All of these properties are important in coping with heat generated by atmospheric friction at escape velocity. Ease of fabrication was pretty important, too.

The large photo shows the two Hetron portions of the capsule: the bottom, in foreground; the heat-shield, at left.

Not only Uncle Sam's sophisticated scientists, but also the more prosaic industrial designers are interested in Hetron. It offers great promise in many different applications.

For example, it makes possible small boats that are fire-retardant. Because it is highly resistant to many acids, it finds wide use in scrubbers, ductwork and similar places where corrosive fumes quickly destroy other materials. It's being used for skylights on piers. One company even enclosed an entire building with it.

Hetron can by no means be considered a cheap substitute for other materials. Designers have been impressed with it and have used it simply because it performs its function better than any other material they might have used. Sometimes it costs less than other materials. Sometimes it costs more. But, in either case, it does things better, longer or more safely than anything else. We've got a data file on it if you're interested. Ask for Hetron File A.

A THOUGHT FOR USERS OF DIE CASTINGS

When you put these seven parts together, you get a highly efficient low-cost pump for emptying drums of gasoline, lube oil or chemicals.

The manufacturer used to die cast these parts. Now he has them molded from a Durez phenolic. The switch to molding from die casting eliminated many finishing and assembly operations. Even the fine threads on one of the parts were flawlessly molded.

The switch to phenolic from aluminum added greater corrosion and chemical resistance. Being non-metallic, phenolics also prevent sparking and minimize the risk of handling volatile liquids.

For more facts about molding with versatile Durez materials, ask for Bulletin D400.

For more information on Durez products mentioned above, check here:

- ☐ Hetron polyester resins (File A)
- ☐ Phenolic molding compounds (illustrated Bulletin D400)

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SPECIAL FEATURE

Maintenance of Injection Molding Equipment

C. Palmer Humphrey,
Vice President
R. C. Molding Incorporated

Maintenance as defined by Webster briefly is "The upkeep of property, equipment, etc." but to injection molding companies, maintenance today has become more and more a greater cost factor than any other item of expense. Every year, manufacturers have improved their equipment with new designs, and molding techniques permit faster cycles. Therefore, the best conceived equipment running 24 hours per day is hard pressed to live up to the utopia of continuous, no-breakdown operation. However, until the engineer's dream of a perfect never-stopping injection molding machine is out of the blueprint stage and operating, we will just have to improve our maintenance programs to cope with or overcome the high cost factor.

Preventive Maintenance Begins with Installation

To most molders, a complete and detailed maintenance program is something every plant manager strives for but never quite achieves. Reason: Such a program would entail a full time crew on this project with no other responsibilities. So the best that can be hoped for is a program of preventive maintenance.

Preventive maintenance can go a long way in making actual maintenance easier. And preventive maintenance starts with the initial installation and test procedure.

The ideal floor for mounting the injection molding machine is concrete. A level should be placed on the tie-rods for leveling purposes. This is important because it can lead to bent tie-rods and serious maintenance headaches. Vibration dampeners or pads can be used to hold shock to a minimum. **Caution:** Perform final leveling after the machine has been connected to power source, as movable die-plate will have to be shifted to the open position.

For easy maintenance later, give due consideration to such items as electrical connections, water-cooling connections, and easy accessibility to panel doors. An idea which may go a long way in making the maintenance program a regular and recurring thing is to keep a maintenance logbook for each injection molding machine, or a consolidated book for a bank of machines. Another idea is to incorporate a timer on the machines so that actual running time could be entered in the logbook. After installation the oil tank should be filled to the level indicated by sighting mechanisms on the machine or pumps. Hydraulic oil must be of the highest quality and capable of long service under severe conditions. Automatic lubrication tanks should be filled with oil also before the machine is started. High pressure grease should be used on Zerk fittings.

Hydraulic System Maintenance

The hydraulic system includes pumps, high-pressure lines, hydraulic valves, solenoid valves and timers. Maintenance of the hydraulic system should be done on a basis of hours run either by hour clock or calendar. One of the most important factors in maintaining this system is using clean oil. If a machine has clean oil, free of water and other contaminates, of the proper viscosity, and not overheated (110° to 125°F), then the maintenance on the working parts will be minimized.

It is most important to change oil on a regular basis, every six months or one year, according to your own operations, or as recommended by the machine manufacturer or oil company. One manufacturer indicates that chemical analysis is the best method for determining when the oil should be changed. When you plan to change oil it is wise to add a special detergent flushing oil at least one week before the oil is to be changed. This additive will act as a laxative to the system, flushing all pipes and valves so that the accumulated gums, resins and sludge will be drawn down to the filter screens, or put into suspension so that draining will remove most of

Maintenance Check-list
see page 601

these contaminates. Use extreme care when working on the system so that foreign materials do not enter the system.

At every oil change you should clean the tank thoroughly, wiping every accessible area and cleaning the filters. When wiping a tank clean use rags of a type that will not leave lint which may later become entangled in the valving mechanism. Also, it is most wise to count the number of wiping cloths before starting this job and when finished, as one lost rag in a tank can result in costly damage to the pumping system.

Filters, other than the mesh type usually found directly connected to the pumps, such as replacement cloth or earth types which, furnished as additional units on machines, should be replaced on regular schedules much more frequently than oil changes. These types of filters are usually bypass type units and have a tendency to fill up rapidly and cease to be of any use once this condition exists.

Changing of the oil in injection machines does not necessarily mean that the old oil should be thrown away. There are filtering machines available for thorough cleaning of this oil and removing of all contaminates which have accumulated during the operating period. Proper filtering of oil will render it ready for use to add to the tanks to bring to level or on a complete fill basis mixed with new oil. This is a practice widely used in the industry, and indicated to be safe, over the last 10 years.

Regular checks for oil leaks should be a part of the hydraulic maintenance program. Oil level and the condition of the hydraulic oil should be determined by visual inspection. Good preventive maintenance also dictates that a close watch be maintained on oil temperatures.

The Hydraulic Oil You Choose Should . . .

1. Provide the optimum seal for the pump.
2. Function at temperatures which will provide the correct operating viscosity without oxidation of the oil.
3. Provide sufficient lubrication to eliminate wear on all moving parts.
4. Have a minimum change in viscosity with change in temperature.
5. Be resistant to foaming or aeration.
6. Precipitate no gums, wax sludge or other deposits.
7. Have no corrosive action on metals.
8. Retain all its original properties for extended periods of use.
9. Provide long and continuous service.
10. Have good demulsibility.

Mechanical Parts

Low readings on pressure gauges on your machines or any unusual noises in the operation should be the answer to the question "Is an overhaul necessary?"

When you do have to replace pump parts or valves, it is always best to replace all moving parts directly related to the worn part. That is, if the vanes and the race are worn in a pump system, follow the manufacturer's suggestion and buy the complete repair kit, containing gaskets, bushings, rotor, and the vanes and race. The labor involved to rebuild a pump is, in fact, more costly than the new parts. One last tip on mechanical parts: check for worn hoses, loose fittings and connections.

Electrical System

Maintenance of the electrical system of an injection machine is also a program of replacement when necessary. In other words, when a limit switch or contact type unit ceases to function replace the complete unit. Don't try to repair a minor part which will stand up for some time while its companion parts are all set to stop.

Electrical breakdowns can be prevented and the life of parts can be lengthened by systematically checking for loose connections and frayed wires. These situations can be the cause of resistance in the system and the resulting buildup of corrosion will tend to shorten the normal life of an electrical part.

A periodical check should be made on the voltage to see if this is not too high or too low. Panels where relays or switches are mounted should have doors tightly fitted to eliminate contamination of dust, etc. Also, a good preventive measure for longer life on heater bands could be expected if a periodical check is made to ascertain that heater bands are tight and have a good bearing on heating chambers.

Maintenance of the pump motor is an important factor in the electrical system. Sealed, lifetime lubricated bearings are parts not to be tampered with. If grease fittings are on motors, grease sparingly at long intervals, usually every six months or as recommended. Overlubrication on motors can be as harmful as too little lubrication. Excessive oil or grease thrown onto the motor windings can deteriorate the insulation, exposing live conductors that will arc and cause fires or will electrically charge ungrounded surfaces. On motors with open cages, try to keep dust and dirt free by blowing out or vacuuming the housing periodically.

Shielding of motors with open cages to prevent plastic pellets or any foreign material from dropping in is insurance against unnecessary breakdowns. Good ventilation of your machines' motors is a must to prevent overheating which is bound to lead to shorter motor life.

Instruments must be safeguarded from shock. Oil accumulation in instrument housings must be avoided and oil temperatures must be kept under 130°F. Proper preventive maintenance calls for locating the instruments on the machine to avoid vibration, shock, dirt, moisture and oil dripping. **Caution:** Do not oil or grease any part of the instruments at any time. All terminal connections should be inspected regularly, both thermocouple and control circuits. Be sure that all lead wire and thermocouple polarity is correct and wires are not damp or grounded. Thermocouples should be examined at regular intervals and replaced when they show signs of advanced deterioration. This inspection should be a *regular routine* even though the control instruments may be equipped with a thermocouple brake protection device. Another instrument maintenance tip: Maintain a minimum inventory of interchangeable plug-in parts.

The heating cylinder on any injection machine is in itself an area for preventive maintenance every day it is used. Good standard molding practices of never allowing the cylinder to become overheated, of never purging or starting a machine when the cylinder is not up to proper heat, or purging thoroughly on week-end shutdowns to remove corrosive type materials, and of following these practices religiously in every day operation, is the best maintenance program for cylinders.

Heating bands and control units should be checked regularly to determine whether they are functioning properly. Burnt out bands not only overload the good bands on a cylinder but also tend to create variables in the heating area which leads to degradation of the raw material, and the cylinder itself.

Actually, maintenance on heating cylinders, bands, pyrometers and timing instruments is an operation that

can be done every time a mold is set into a press. If a plant's setup man is instructed to, and gets into the habit of, systematically checking all these areas before starting a press on a production run, the time involved for this checking is minor compared with the downtime in the middle of a run to correct some small repair, to say nothing of bad production. A final thought on maintenance of the electrical system: Use proper size fuses in disconnect switches and on machines.

Lubrication

Lubrication of machines on a rigid time basis is a most important part of any injection molding plant's preventive maintenance program.

A complete survey of the plant should be made to determine lubrication requirements, and the information should be entered on the machinery records.

If possible, improvements should be made at the time of the survey. Automatic feed oil cups, mechanical force feed lubrication systems, and the special fixtures which will enable the lubrication man to oil parts in remote locations without danger from moving parts, should be installed. Another important point in lubrication, especially the automatic type that is commonly used on linkage of presses or other areas that are covered by an automatic oiling or greasing feature, is a periodical visual inspection, to check the various areas that should receive lubrication, to confirm these points are, in fact, being lubricated.

Some companies devise a color code which indicates the different lubricants used and their frequency of application. The points of lubrication, oil cups, oil feeds, and oil holes are painted according to the color code which is shown on a chart supplied the oiler.

On fully hydraulic-operated injection presses a minimum amount of maintenance is required because the rams are lubricated by their own medium of pressure and tie rods can be lubricated by either oil reservoirs or grease cups. However, on toggle-actuated presses a strict greasing schedule must be maintained. Toggle arms, bushings and pins must have new grease at frequent intervals because the high clamping pressures are constantly squeezing out the lubricant. The action of the toggle setup creates a wiping motion at every cycle so that if these parts of this type of press are not kept completely lubricated at all times repairs will be frequent and costly. There is no short cut to the frequent greasing of toggle systems.

Maintenance of Molds

Another important area of maintenance in an injection plant is the molds. These are the tools by which production is created. Good maintenance habits should be automatic at the end of every production run. These should include the close inspection of the last full shot to see what repairs should be made to correct inaccuracies in the molded part. This is, of course, a tool room problem. Whether it is your own tool room or an outside shop, these faults should be corrected. Worn leader pins and bushings should be replaced. Bent or broken knockout pins and plates should also be corrected.

If, upon inspection, a mold is found to be ready for storage, your best maintenance procedure should be to blow out thoroughly all water residue from the cooling holes, to coat all areas of the mold, such as cavities and forces, with a top grade rust preventative after wiping dry these parts of the mold. A good idea to prevent rust in storaged molds is to keep apart the two halves by inserting at the ends or sides pieces of thin plywood or fiberboard. This allows an air space to prevent buildup of condensation in closed cavities.

Auxiliary Equipment

In every injection plant the auxiliary pieces or equipment necessary to operate properly are many and varied.

Maintenance Check-List for Injection Molding Machines

daily

- ☐ Grease all links and sliding parts
- ☐ Lubricate tie rods and toggle linkage
- ☐ Check hydraulic oil level and temperature
- ☐ Check pump pressure (avoid exceeding maximum rating)
- ☐ Check mold clamps
- ☐ Grease mold guide pins, bushings, slides, return pins, etc.
- ☐ Check heater bands for loose connections
- ☐ Check degating fixtures
- ☐ Check oil filtering machine
- ☐ Check for tools left around moving machine parts

weekly

- ☐ Check thermocouples at cylinders
- ☐ Check temperature control (on-off range)
- ☐ Check temperature control zero reading (room temperature)
- ☐ Record load current and voltage on motor during operating cycle—record overload time as percent of full cycle at full load
- ☐ Check air compressor oil
- ☐ Drain water from air compressor
- ☐ Check oil in well pump
- ☐ Check oils and battery in Mobilift
- ☐ Grease and oil grinders

monthly

- ☐ Clean oil strainers and filters
- ☐ Check all control wiring for loose connections
- ☐ Clean main valve spools
- ☐ Check condition of hydraulic oil (viscosity, appearance, etc.)
- ☐ Tighten all fram assemblies and mountings
- ☐ Grease Mobilift

every six months

- ☐ Replace or refine oil—check viscosity before changing
- ☐ Grease and oil water pumps
- ☐ Check motors on coolers
- ☐ Check motors and belts on grinders

annually

- ☐ Clean lighting fixtures

For plant-use Check-Lists, write SPE Journal, 65 Prospect St., Stamford, Conn.

Up to 5 full-page-size Check-Lists will be sent without charge, while they last.

PHILLIPS 66 MARLEX PLASTICS

BRIEFS

SALES SERVICE LABORATORY REPORT 60-2

What's Happening to Filaments!

To paraphrase a current cliche: "Will success spoil MARLEX* Filaments?" Or to put it another way, now that production and fabrication have been worked out: "Has the bloom faded from the resin?" We think not . . . and in keeping with this thinking, we at the laboratory continue to plug away, working on new techniques . . . spinning methods, coloring, filament treatment, new kinds of filaments, yarn, etc.

Let's look at the success picture. A few years back, when MARLEX high density polyethylene was introduced, the knowing ones said it would make a dandy filament. It's easily drawn, tough, lightweight . . . it can be oriented to give a filament of high tenacity . . . and it's resistant to water, chemicals, oils, bacteria, fungi, heat (250°F) and cold (−180°F). They were right. Today, the use of filaments made from MARLEX high density resins is ever expanding—rope of every kind, nets, fabrics, rugs, filters . . . all manner of things from medical sutures to men's belts.

In connection with MARLEX rope, we are asked the same question over and over. Isn't it more expensive than manila rope? Our stock answer: "Sure it is . . . initially! But look at all the extra performance MARLEX rope gives. It's stronger, lighter, rot-proof, more economical in the long run." Extensive lab tests and common sense say that our rope is less costly when performance is considered along with initial cost. For those "Missouri skeptics" who want more proof, we offer the results of a 15-month test on a fleet of tugs used for off-shore drilling in the Gulf of Mexico —heavy, rugged usage to say the least. Here, it was found that, while two-inch diameter MARLEX line costs 2.3 times more than equivalent size manila line, the longer life of MARLEX rope actually meant an 18% saving in rope costs. This two-inch MARLEX rope weighs 0.70 pounds per foot and has a breaking strength of 46,000 pounds, while the same size manila weighs 1.08 pounds per foot and breaks at 31,000 pounds. Any wonder why the use of MARLEX rope in all sizes is growing!

Ribbon Yarn, Too

Ribbon yarn refers to a flat, sometimes folded, narrow ribbon of film. Ribbon yarn made of MARLEX has a beautiful decorative effect. Like filament it is oriented to give strength and low stretch. The applications for these yarns are growing in woven materials—seat covers, upholstery, and the like. It can be used alone or combined with other yarns. As with filaments, extruders of ribbon yarn know they can depend on the uniformity of MARLEX resins to give them maximum production rates. High quality, virgin resin pays off here.

We've acquired some know-how on filament and yarn applications. It's yours for the asking.

Sheet and Forming

We have always felt that someday sheet extrusion and the forming of sheet would use a goodly share of our resin production. After all, the objects formed from steel and aluminum sheet are almost beyond counting. Why not the same for MARLEX, once sheet extrusion and forming techniques are perfected?

It looks as if the time has come. Every day now, we hear of new sheet-formed items. The real indicator is the growing number of really large items being thermoformed from MARLEX sheets. Some people said it couldn't be done because of the sheet sag. Today, it's being done—a 5-foot children's boat, jet engine intake covers larger than 40 inches in diameter, large tote boxes, toy autos. Pretesting for sheet properties to control sag during forming is the answer. We do it every day in the lab. To the eye there are few distinctive attributes about a flat, smooth, uniform sheet. But there are properties in sheet that dictate the forming particulars.

The quality of the sheet starts with the extrusion equipment. Long barreled extruder, well designed screw, good temperature control, well constructed die, temperature controlled polishing rolls plus good take-off equipment are all important. We aren't keeping any secrets—just write and we'll send you details on controlling extrusion quality as well as evaluating sheet to determine thermoforming characteristics.

*MARLEX is a trademark for Phillips family of olefin polymers.

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Scrap grinders are, of course, a must, but in any plant there is such equipment as material heating ovens, dry coloring units, hopper dryers and loaders, weigh feeders, water pumps, wells, materials handling equipment such as a gas or battery-driven high-low, air compressors, counting scales and many other pieces of equipment and tools. These varied pieces of equipment pose a serious maintenance problem because of their different operating methods. All of these have points of maintenance that should be properly and periodically serviced. *The best and only way to cope with this situation is to set up some period of time in which each piece of auxiliary equipment is systematically inspected for wear and adjustment.* Such equipment as weigh feeders should be inspected and adjusted more often than an oven, perhaps; nevertheless, each piece of equipment should have its own time for inspection whether it is on a more frequent daily or weekly schedule or as long as once every year.

Another area of good maintenance practice is to insist upon good housekeeping and safety practices. With clean machinery, maintenance men or production supervisory personnel can quickly spot areas that will need repairs before the actual breakdown. A program of good housekeeping and safety practices goes hand in hand with a good preventive maintenance program.

Your maintenance program should be tailored to suit your plant and operations. It should be revamped and changed often to suit the varying conditions as there is no such thing as a perfect program. The very fact that time takes its toll on all machinery is reason enough to change set schedules to suit the age of your equipment.

Whatever program of maintenance you commit yourself to, make sure that it is followed religiously. If it is proven to be impractical and costly, review your program and change it to obtain the results of less down time which you must realize in order to operate efficiently and profitably.

Your maintenance program can make or break your operation. Enter into it with the same astuteness and planning with which you started your business. It will be with you as long as you are in the injection molding field and is a factor that will add to or subtract from that which is most important to any business—PROFIT.

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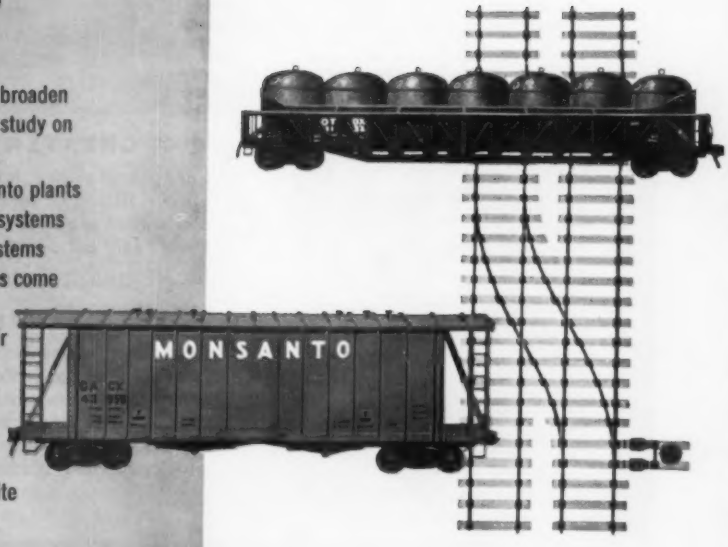
To "Bulk" or not to "Bulk"?

As part of Monsanto's comprehensive program to broaden and facilitate the general use of plastics, a 5 year study on the question of bulk handling was just completed.

This study drew on practical experience in Monsanto plants and in the plants of customers. The popular bulk systems were thoroughly examined and evaluated; new systems were developed and explored. Out of the study has come "A Report to Management on Bulk Handling", a valuable guide to manufacturers in reaching their individual decisions. Out of this study have also come bulk handling services which are shipping millions of pounds of Monsanto Polyethylene, Lustrex styrene, and Opalon vinyl.

If you would like a free copy of the full report, write to Monsanto Chemical Company, Plastics Division, Room 713, Springfield 2, Mass.



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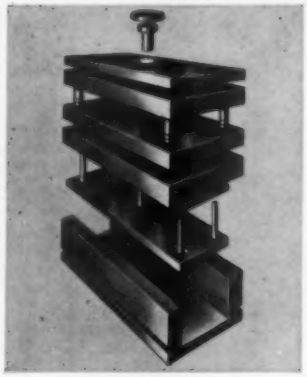

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MOLDMAKING

Tolerances in Moldmaking

With newer plastics making more and more inroads on metals applications, parts have to be molded with greater and greater precision. This article describes—for the first time—the impact of this revolution on the making of molds.

In general, mold construction involves two main categories of tolerance application. First, there are tolerances as applied to the mold dimensions that affect the mechanical function of the mold proper, as related to the proper fits of sliding cams, cavity and force inserts, leader pins and bushings, cut-offs, and the like. Second, there are the tolerances that are applied to those portions of the mold that govern the dimensions of the part to be molded. It is this second category that we should like to discuss in this article.

It is interesting to examine just what a dimension of a molded plastic part is made up of. In the main, there are at least four variables that affect a molded part dimension. They are:

1) Mold Dimension
2) Geometry of the part
3) Shrinkage of the material used
4) Conditions of molding

Once the mold is made, Items 1 and 2 are fixed and cannot be changed without the expenditure of money and time. Items 2, 3, and 4, are tied together to a degree in that one has an effect on the other. The shape of the part will have an effect on the direction and magnitude of the material shrinkage. The conditions of molding, or cycle, will also have an effect on the ultimate material shrinkage. On the other hand, the shape and wall thickness of the part, will, in turn, limit the conditions of molding.

Whenever a tolerance is given on a part drawing, we are faced with the decision as to what portion of the tolerance is to be allotted to the construction of the mold, and what is to be retained for the variables in molding. We must remember, however, that the holding of close tolerances in mold construction often adds to mold cost.

Let us study a typical example of a molded part that has an outside dimension of $1.000^{+.000}_{-.004}$. Further this dimension involves an irregular shape and in its function it will fit into another part. These facts indicate to the moldmaker that he should take all his tolerance on the *low* end of the dimension. If, for example, we arbitrarily decide that 25% of the indicated tolerance is to be used for mold construction, the mold dimension would become $.997^{+.000}_{-.001}$. This would leave the major portion of the tolerance for molding considerations. Further, it leaves the mold "steel-safe". This means that additional refinements in mold dimension can be made by removing steel rather than the more costly and time consuming operation of adding steel.

Now, let us consider the same basic dimensional range we just discussed, but change it to this form, $.998^{+.002}_{-.002}$. We still have a total of .004" in tolerance but, not knowing more about the function of the part, we have in essence cut the tolerance in half. In aiming for the average, we have but .002" on either side.

What does this mean to the moldmaker? In quoting a job such as this, in the case of the first example, he might consider hobbing the cavity components as the most inexpensive way of doing the job, since it involves an irregular shape. If, however, his tolerance is cut in half, he may fear the hobbing procedure in that there is a greater possibility of distortion in heat treating. In quoting the job from a machining point of view, his costs would be considerably higher. It is conceivable that on a multiple cavity mold, this difference could go into thousands of dollars in amount.

The point we would try to make from these examples, is that extreme care should be taken in setting the tolerances on a molded part. Wherever possible, the tolerance should be indicated in one direction only to give the moldmaker a clue to his "steel-safe" position. Further, close tolerances are costly in mold construction and should not be indicated unless needed.

Often a part is converted from some other material into plastics. In redrawing, the designer will carry through the same tolerance pattern. This should not be done without careful consideration and new evaluation of the part as a plastic component.

—— ■ ——

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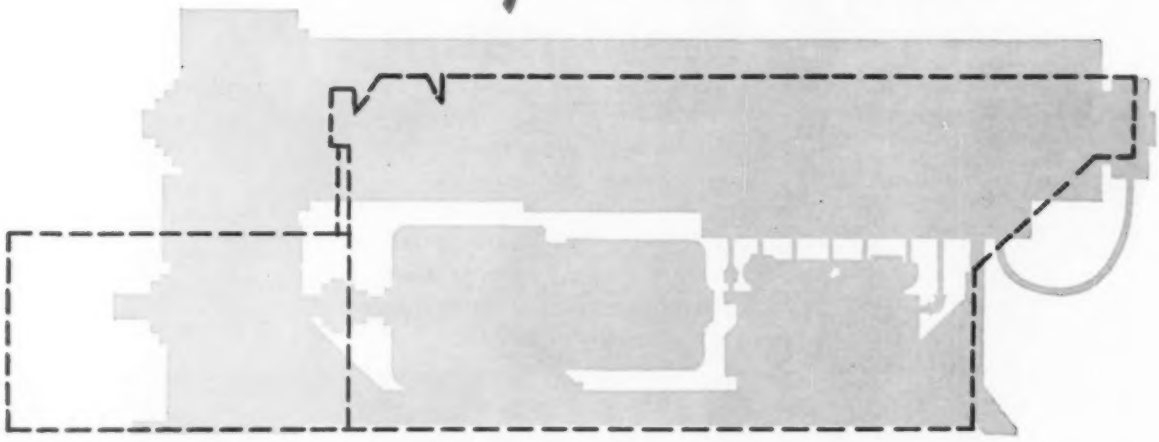

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SPEAKING OF EXTRUSION

Extrusion Blow Molding Techniques For High Density Polyolefins

Until about the middle of 1958, practically all blow molding equipment was cloaked in secrecy. A very limited amount had been imported from Europe but the "squeeze" bottle industry was based on machinery which the bottle makers had developed and built themselves. Then, suddenly, there was a tremendous surge forward with a great number and variety of blow molding machines becoming available commercially. A number of American-built, packaged units were developed and put on the market in rapid succession. However, prior to the commercial availability of blow molding equipment, a small extrusion blow molding unit was designed and built in the laboratories of Phillips Chemical Co. Operation was based on a continuous, alternate flow system, and two dies.

The polyolefins referred to throughout the following sections are: Marlex* Resin No. 6002, a 0.96 density polyethylene homopolymer used where maximum stiffness is desired, and Marlex Resin No. 5003, a 0.95 density ethylene/butene copolymer employed wherever resistance to environmental stress cracking (ESC) is of paramount importance. In actual practice, it was found that these two polyolefins could be processed under essentially identical extrusion and molding conditions. Also, they exhibited the same response to processing conditions as far as shrinkage, surface appearance, etc. are concerned. Hence, no further distinctions will be made in this report on processing (except where ESC is related to mold design.) Nevertheless, it should be kept in mind that blow molding applications for these two materials may differ appreciably.

* Trademark Phillips Chemical Co.

Extruder

The extruder is a standard 1½" MPM machine, with an L/D ratio of 16:1. The screw used for blow molding is a rapid transition, metering type with a 4:1 channel depth ratio. The only screens normally used are a 20, 80, and a 20 mesh in that order in the usual location at the front of the extruder barrel. The output, with two dies designed for 4 to 5 oz. bottles, is 20 to 25 lbs./hr. With less restriction of the output, the same 0.2 to 0.3 M.I., high density polyolefins can be extruded at a rate of over 35 lbs./hr. on this machine. The extruder delivers the homogenized melt directly to an in-line, "T"-head mounted in the blow molding unit. Operation of the unit is shown in *Figure 1*.

"T"-Head and Dies

In *Figure 2*, the sliding glass panels have been removed to show the location of the "T"-head and dies inside of the blow molding unit. The stream from the extruder (at upper left in photograph) follows a 1" I.D. channel to a plug valve where it is diverted alternately to the right and then to the

Figure 1. Extrusion bottle blowing equipment in operation. Installation comprises an extruder, portable blow unit attached to front of extruder when in use, and separate control console connected by cables but also portable.

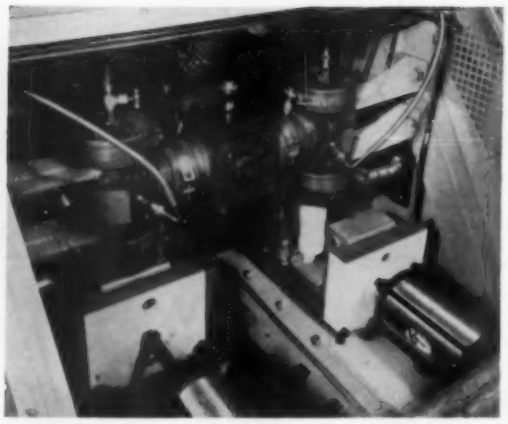

Figure 2. Sliding glass panels have been removed to view inside blow molding unit during operation.

left, feeding a single orifice die with each movement. The plug valve is actuated by a 3⅛" diameter air cylinder.

As drawn schematically in *Figure 3*, the valve utilizes a simple tapered plug but it was necessary to line the valve body and to spray metallize the plug with tungsten carbide in order to prevent galling. The valve must rotate rapidly every few seconds while at an elevated temperature and also while maintaining a tight seal against leakage, all without a lubricant (which would contaminate the melt). These are severe conditions for any metal but the tungsten carbide has given excellent service. Many commercial machines use outboard bearings for the plug as another means of avoiding this same problem.

The two parison dies shown on each side of the square valve body in *Figure 2* are simply tubing dies mounted for downward extrusion. The blowing air is admitted thru the top to a bore in the mandrel. The concentricity of the extruded tube or parison is adjusted by moving the die bushing. The bushings and mandrel tips are each quickly interchangeable with those of other sizes to yield parisons of assorted diameters and wall thicknesses.

As indicated in *Figure 3*, all interior contours of the dies should be well streamlined. All inside surfaces should also be highly polished. These factors are extremely important in blow molding since any defects, such as lines or thin areas, are greatly magnified when the parison is blown out to the shape of the mold.

The effect of die land length is exemplified by the following results obtained in the course of test work. Bottle "A" was made with a 1/32" land and a 22° approach angle. The surface had a fine, crepe paper-like appearance and striations were evident. Bottle "B" was produced with a ¼" land and a 34° approach angle. This bottle was smooth and entirely uniform in appearance. Both bottles were made under the same conditions and to the same wall thickness with a 0.375" I.D. bushing and a 0.250" O.D. pin or mandrel in each case. Land length was obviously the controlling factor. Also, these results agree with experience obtained in the extrusion of pipe and tubing from high density polyolefins where we consider an 8:1 ratio of land length to wall thickness as probably a minimum for good extrusion.

Molds, Platens, and Cut-Offs

The split molds used move in horizontal directions only, immedi-

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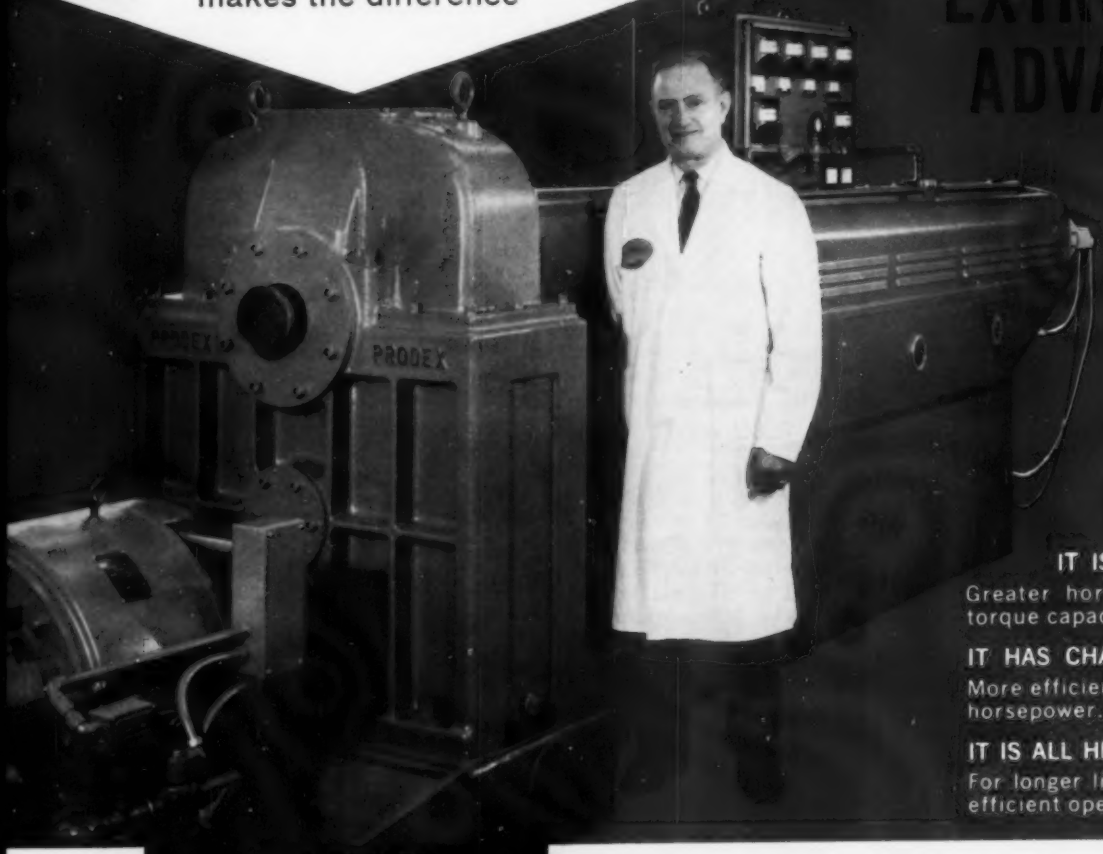

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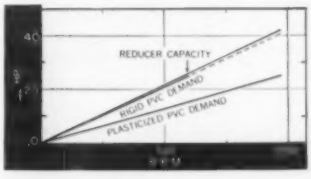
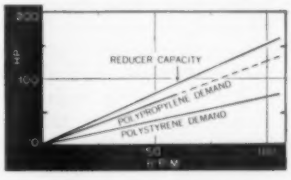


EXAMPLE 2.

The new 4½" PRODEX **HT** EXTRUDER, equipped with a 75 HP Dynamatic drive and gearing for 90 rpm max. screw speed, turns out 650 lbs/hr of high impact polystyrene without predrying. In order to run polypropylene M.I. 0.2, change gears for 65 rpm max. speed are used to deliver about 500 lbs/hr of this material. Without change gears, this machine would need a 125 HP drive, which would result in a substantial horsepower waste.



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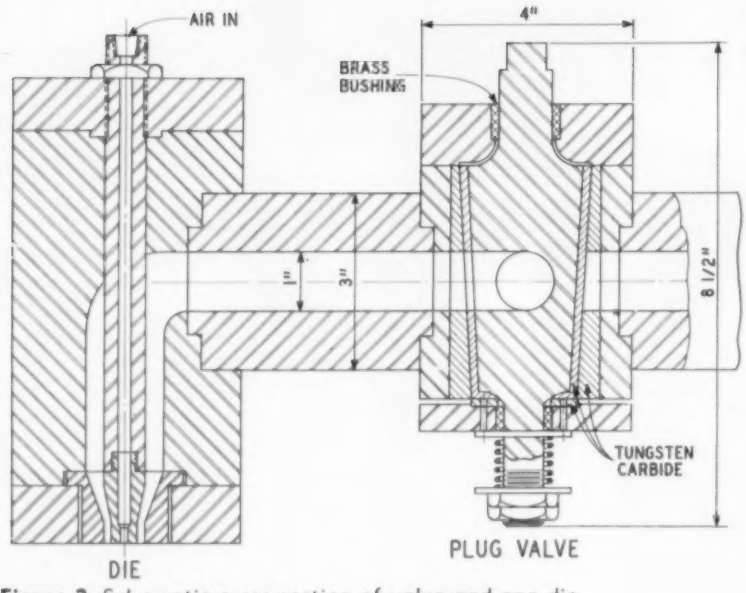


Figure 3. Schematic cross section of valve and one die.

ately below the twin dies. As shown in *Figure 2*, the mold platens each slide on a pair of horizontal "V" rails. Each of the four platens is powered by a 3⅜" diameter air cylinder. With our 100 p.s.i.g. air supply, these cylinders provide sufficient clamping pressure for a maximum projected molding area of about 17 sq. in. at 60 p.s.i.g. blow pressure without parting the molds. The guide rails and therefore the platens are adjustable vertically to accommodate molds of various heights. Since the blowing is done through the dies, the molds must be adjusted to within 0.002"-0.004" of the die face to confine the parison and so prevent "blow-outs" during the blowing cycle.

The molds are all made of aluminum in our work because aluminum is an excellent heat conductor, easy to machine, and adequately durable. For extremely long runs, steel molds might be preferred although at some sacrifice in cycle time.

When designing and building molds for high density polyolefins, great care should be taken to insure perfect mold closure and perfect alignment of the mold cavities. Any misalignment or poor closure will result in thinning along the mold parting lines. Apparently, the material cools more slowly along these lines where intimate contact with the mold is not achieved. Hence, due to the high hoop stresses developed by the internal air pressure as the part cools and shrinks, the walls will be thinned out across these narrow zones where heat has been kept.

The requirements for mold channeling are difficult to define because of the almost infinite variety of sizes, shapes, and wall thicknesses which are feasible. Naturally, the channeling should be adequate to prevent any significant heat build-up in the mold. Particular attention should be given to the neck and pinch-off areas, i.e., the top and bottom of the molds, since the molded parts will be thicker in these areas and more heat must be removed.

With the largest aluminum block molds tried so far (about 6" x 5" x 4" when closed), the ¾" to ½" drilled channels are entirely satisfactory. For small symmetrical items, four vertical channels located close to the mold cavity but spaced 90° apart (each offset 45° from the top parting line) will generally take care of the thinner areas in our molds. These vertical channels should be connected by horizontal channels located as close as possible to the neck area, the pinch-off and any other thicker sections. Even with smaller items, more than one set of horizontal channels in any one area may be indicated.

The design of the mold cavity will be determined by the part desired. However, it will be easier to mold good parts if the part itself is properly designed for blow molding. Sharp angles should be avoided. All corners, ribs, etc. should have radii to minimize thinning or molded-in stresses. If a very smooth surface is desired, the cavity should be polished to a 2 RMS finish. Various other finishes or textures can also be incorporated into the mold to give decorative effects and/or additional utility to the finished items.

The cross-section of the test bottle mold given in *Figure 4* illustrates a number of different features. For testing purposes, it incorporates some of the design features of several bottles now being produced commercially. At the time it was built, it was needed to evaluate polymers for these new applications. It had already been shown that the much-used 4 oz. Boston round bottle was too "non-critical", i.e. that excessively long test periods were required because of the excellent ESC resistance of the new 0.95 density polyolefin copolymers. Hence, a number of fairly sharp angles were deliberately designed into the body of this bottle. In combination with maximum test temperatures and severest test conditions, this design then provided a means of accelerating a resin screening program. Thus, it was possible to select the best resin for these applications in the shortest time.

Apart from the sharp angles and small radii in the body of the bottle, *Figure 4* illustrates several worthwhile features. The ¼" radius in the chime area avoids the stress cracking which is prone to occur in the transition between the thick, pinched section and the much thinner corner. The 3" radius at the bottom of the bottle is simply to insure that the bottle will rest flat. The 1/16" wide land underneath, which is

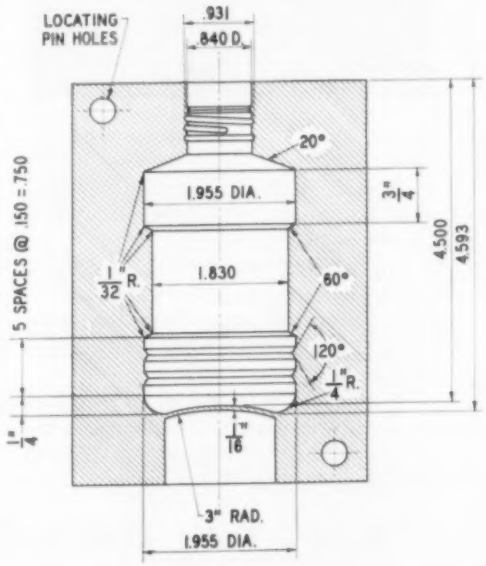


Figure 4. Design of test bottle mold.

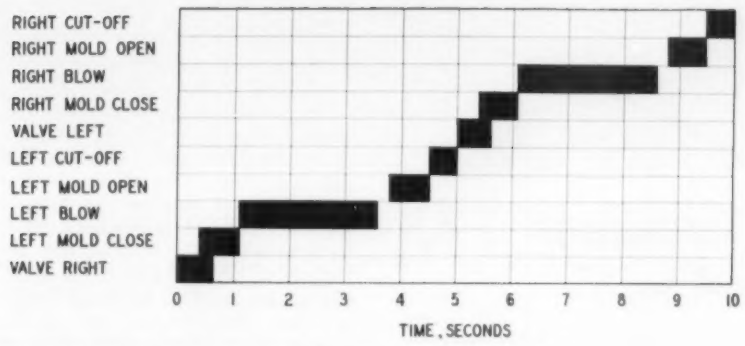


Figure 5. Typical cycle with alternate flow to two dies.

relieved by 0.003" in each mold half over the center ¾ of the land, provides for easy removal of the short pinch-off "tail". But even a short tail may adhere to its own or other bottles when hot and so the cavity below is intended to flatten and cool that tail. To do this, the depth (perpendicular to the plane of the paper) should be only about twice the thickness of the parison wall. Regarding the neck at the top of this same bottle, the dimensions given are to fit a No. 22 cap.

The final operation in the blow molding unit is the cut-off and delivery of the parts to the outside. We use a spring steel blade, actuated by a 1" diameter air cylinder with a 4" stroke, to cut the parison at the die face immediately after the part is blown and the split mold opens. These cut-offs may be seen, projecting through the sides of the cabinet at right angles to the direction of platen travel, in *Figures 1 and 2*. From the cut-offs, the parts drop onto a central conveyor belt which delivers them to an external chute.

Control Cabinet

All functions of the blow molding unit are controlled from the separate, portable console to be seen at the left in *Figure 1*. The band heaters located along all legs of the "T"-head and around the dies are controlled in zones by the three proportioning instruments across the top panel. Readings from the stock temperature thermocouples for the same three zones are indicated on another panel near the extruder.

The steps in the blow molding cycle may be controlled manually by push buttons on the slanted panel of the console or completely automatically with the timers in the cabinet underneath. Multiflex Reset Timers, manufactured by the Eagle Signal Corp., were used. These have a calibrated vernier scale providing a 0.1 second adjustment in any step of the cycle. A typical program of 5 seconds per bottle or 10 seconds for a full machine cycle is illustrated by a bar graph in *Figure 5*. Note that there is a slight pause between "Blow" and " Mold Open" for each mold. This allows time for the blowing air to exhaust from the molded part and so prevents possible deformation of the parts. The cycle may be increased or decreased only by changing the "Blow" time. The other steps in the cycle are essentially determined by the characteristics of the machine.

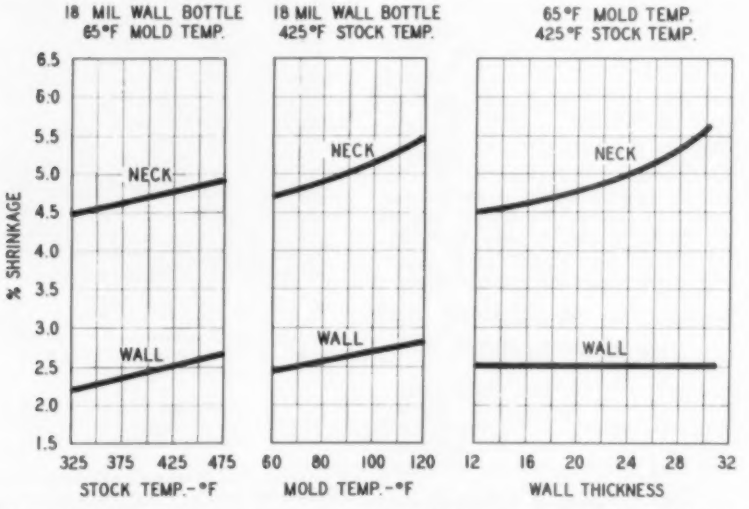


Figure 6. Effect of stock temperature, mold temperature and wall thickness upon shrinkage in both neck and body of test bottle.

Stock Temperature

Generally, *stock* temperatures of about 400°F will yield parts of optimum quality at good molding rates. Temperatures from 300° to 500°F are feasible but these extremes should be used only to meet unusual requirements. For example, in blow molding parts with very thick walls, it might be advantageous to go to stock temperatures below 400°F in order to reduce the amount of heat which must be removed. Surface smoothness tends to be better on thicker parts, anyway, and so a faster cycle could be achieved without sacrificing appearance.

As a rule, when the stock temperature is increased:

1. Surface smoothness and gloss are improved.
2. Less blow pressure is required to produce good parts.
3. Cycle time must be increased.
4. Shrinkage of the part is increased.
5. Parison "swell" is decreased.

The first graph in *Figure 6* shows the effect of stock temperatures on the shrinkage of the test bottle detailed in *Figure 4*. "Neck" refers to measurements across the sealing ring, the 0.931" dimension in the mold, while "Wall" refers to measurements across the body of the bottle, the 1.830" diameter, at the location where this dimension is given for the mold. It will be noted that the shrinkage in the neck area is considerably higher than in the body. This may be explained on the basis of the hoop stresses developed during molding. Thus, for this particular bottle, the hoop stress in the body is four times greater than in the neck. Hence, the normal contraction during cooling is offset by hoop stresses much more in the body than in the neck.

There was no indication found of any adverse effect on pinch-off as the stock temperature is increased although this effect has been reported for lower density polyethylenes. Conceivably, very slow cycling machines, which leave the end of the parison exposed in mid-air for extended periods, might produce parts with a weak

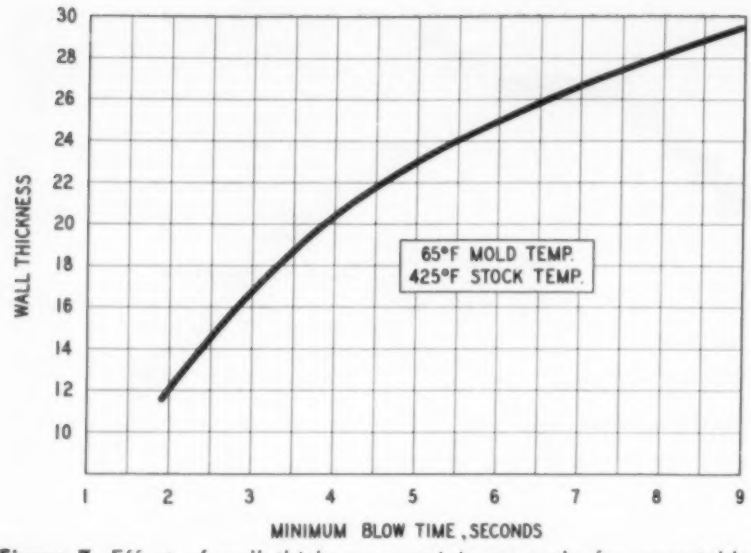


Figure 7. Effect of wall thickness on minimum cycle for acceptable bottles.

pinch-off because of oxidation on the surface of the molten parison.

The obvious importance of stock temperature in good blow molding practice dictates a need for melt or stock temperature thermocouples in the melt stream. The metal temperature indications normally available provide a good operating guide but only after the optimum conditions have once been established for each item.

Mold Temperature

Tap water will generally provide adequate mold cooling for good cycles but we have a chiller available for experimental work since our incoming water will sometimes reach 85°F in the summer. In going down to actual mold metal temperatures of 30°F under sustained operation, no adverse effects on the quality of the parts produced were noted provided that suitable adjustments were made. A higher and/or faster blow is needed with colder molds to obtain good wall uniformity and surface smoothness, especially with thin-wall items. *Lowering* the mold temperature has the following effects:

1. Cycle time is decreased.
2. More blow pressure is required for good parts.
3. Shrinkage is decreased.

The second graph in *Figure 6* shows the effect of mold temperature on the shrinkage of a test bottle, determined as described above.

Blow Pressure

The blowing pressure and rate of blowing are very important when blow molding high density polyolefins. Insufficient blow pressure may result in rough surfaces on the part, slow cooling, and non-uniform walls. Even more apparent will be a thinning at the mold parting line, plus a distortion of the item when excessively low pressures are employed. For example, when running test bottles with a 20 mil (0.020") wall and using 425°F stock plus a 65°F mold, thinning and distortion became rapidly less apparent as the blow pressure was increased above 10 p.s.i.g., and it disappeared entirely at about 60 p.s.i.g. As a guide, it may be said that *higher* blow pressures are needed with:

1. Thinner walls.
2. Lower stock temperatures.
3. Lower mold temperatures.

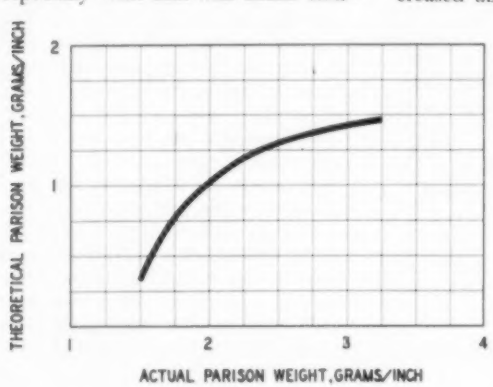


Figure 8. Effect of die opening on degree of "swell."

Wall Thickness

The minimum blowing, i.e., cooling time of a part is naturally governed by the wall thickness. *Figure 7* shows a plot of wall thickness vs. minimum blow time *for acceptable bottles*, with other conditions held constant. This data was obtained by starting with a long cycle and progressively decreasing the cycle in ½ second increments until the test bottles first began to deform from lack of sufficient cooling. The minimum time before deformation was then plotted against the average wall thickness in the body of the bottle. The neck and pinch-off areas were, of course, two to three times thicker.

Since wall thickness governs cooling rate, it may also affect shrinkage. The third graph in *Figure 6* gives our results for this variable, with the shrinkage measured as described previously.

The average wall thickness for any one mold is determined by the cross-sectional area of the parison. This, in turn, is related to the annular opening in the die by the degree of "swell" or expansion which occurs as the parison issues from the die. Hence, it is essential to have some information on the degree of "swell" to be expected when designing a die for a part with a specific wall thickness. By weighing the parisons extruded with various annular openings and plotting these figures against the calculated weight of theoretical parisons from the same dies, assuming *no* "swell" or drawdown, a measure of "swell" is obtained. *Figure 8* is a plot of this type, indicating the results to be expected with high density polyolefins over one specific range of conditions. The fixed conditions in this case were: 0.375" I.D. die bushing, 425° melt temperature, and a ¾" to 1" per second extrusion speed. The O.D. of the pin (mandrel) was changed to vary the annular opening. Under these conditions, the degree of "swell" was about 2:1 over the range measured. Under other conditions, different results might be obtained. Generally, the degree of "swell" will decrease with:

1. Increasing parison diameter.
2. Higher stock temperatures.
3. Lower extrusion rates.
4. Longer die lands.

—— ■ ——

edited by
Bruce H. Maddock,
Union Carbide Plastics Co.

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE* polyethylene resins

JUNE, 1960 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Molded polyethylene containers which can be hermetically sealed by automatic packaging machines are now available for frozen or chilled foods. The semi-rigid containers are reported to be useful for many applications where plastic has heretofore been inadequate due to problems of leakage or dehydration. After the containers are filled, polyethylene film is heat sealed around the reclosable lids, thus hermetically enclosing the contents of the package. A convenient pull tab is provided for initial opening.

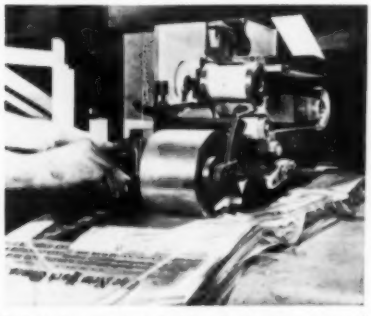
The containers are currently produced in pint and half-pint sizes. They are supplied in from one to four colors or can be left with a clear background for product visibility.

The manufacturer claims the polyethylene containers offer shipping and handling economies because they are lightweight and unbreakable.

Safety snap-on caps which fit tightly over medicine bottles, are a recent polyethylene development. They make it virtually impossible for children to get at the bottle's contents, yet adults can easily remove the caps with a flick of the thumb. The closures are said to stay secure no matter how often they're used.

Newspapers in heat-sealed polyethylene bags are now being mailed to suscribers for the first time, reports a metropolitan publisher.

Copies of the paper's Sunday edition are bagged at the rate of 1,500 per hour, using semi-automatic baggers and a continuous heat sealer. A special machine handles rolls of pre-addressed labels, coated on the reverse side with a thermoplastic adhesive.



Roll stock, pre-printed with subscriber's name and address, is automatically heated, cut, indexed and placed on the bags by the labeling attachment. The thermo-plastic coating of the label adheres firmly to the polyethylene bag.

The pre-formed 14 x 19½" polyethylene bags permit copies to be shipped flat, facilitating handling, stacking and shipping.

Newspaper officials report that the 1.5 mil polyethylene bags protect papers against rough handling, soiling, tearing and weather. They agree that the improved appearance of the paper should have an influence on customer re-orders of mail subscriptions.

U.S.I. Introduces Three New Polyethylene Blow Molding Resins

New PETROTHENE Resins Produce Bottles of Excellent Appearance, Are Easy to Process

U.S.I. has developed three new PETROTHENE polyethylene resins with properties particularly suited to individual blow molding requirements. Two of the resins can also be used for injection molding. All have been evaluated by U.S.I.'s Polymer Service Laboratories and have been successfully field tested.

PETROTHENE 101 and PETROTHENE 102-2 can be used in both blow molding and injection molding, the first in applications requiring high stiffness and good stress crack resistance, the second in applications where stiffness and impermeability to liquids, oils, and gases is important. PETROTHENE 209-2 is designed for use in blow molding, especially for relatively small moldings with thick side walls.

Each of the resins is easy to process and produces bottles of outstanding appearance, good stress crack resistance and excellent low-temperature flexibility.

Lower Cost Per Container

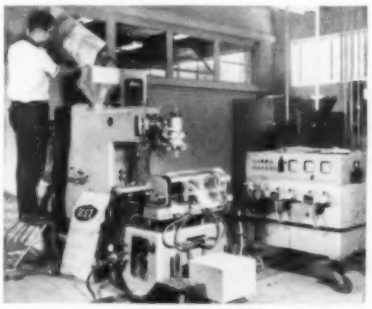
High stiffness and good stress crack resistance are the key characteristics of PETROTHENE 101 (density–0.924, melt index–2.0). This permits a reduction in wall thickness and consequently, a lower cost per container. Its torsional modulus of elasticity is approximately 18,000 lb/sq in. higher than the best of three other similar polyethylene resins commonly used for blow molding.

The stress crack resistance of PETROTHENE 101 was tested in an accelerated shelf-life test by filling thin-wall tubes molded of the resin with a commercial detergent and holding them at 120°F for 4 months. There were no container failures even though the metal closures were beginning to show signs of corrosion.

Carboys For Chemicals

High flow rate is the key characteristic of PETROTHENE 102-2 (density-0.924, melt index-2.0). This makes the resin particularly useful in blow molding pieces 6 to 20 oz. or heavier.

Because PETROTHENE 102-2 is also highly impermeable to liquids, oils and gases, it is a desirable resin for blow molding large carboys for liquid chemicals. However, normal precautions should be observed in producing containers for chemicals which act as stress cracking agents.



Extrusion blow molding machine in operation at U.S.I.'s Polymer Service Laboratories, used for evaluating the new PETROTHENE molding resins.

Small Bottles a Natural

The excellent low-temperature flexibility of PETROTHENE 209-2 (density 0.920, melt index-3.0) makes it ideal for bottle blowing where the moldings are relatively small–under 10 oz.–and have thick sides. Its stress crack resistance is comparable to that of competitive resins used for the same applications. In field evaluations, cycle times with this resin were found to be faster than those of comparable resins. Yet seal strength at the parison pinch-off point–often a problem when blow molding cycles are shortened–is good.

Data Available On Silk Screen Printing Machines

A manufacturer of machines for direct printing on polyethylene bottles and other containers is offering a brochure describing the company's line of equipment. The machines, which are automatic and semi-automatic, can print on flat, cylindrical and conical surfaces, and even on objects of awkward shapes. Multicolor printing is possible by printing one color and allowing it to dry before applying the next.

New Twin-Station Machine For Versatile Blow Molding

A new twin-station blow molding machine which permits simultaneous operation with either identical or different molds has been developed. For example, a toy can be blown in one station at the same time a two-quart bottle is being blown in the second station.

The machine's capacity is large, accommodating molds up to 36" by 21" wide and 28" daylight with a 12" stroke. Equipment is said to be safe, simple and low in cost to operate and maintain.

exceptional moisture and grease resistance

POLYETHYLENE-COATED KRAFT OPENS UP NEW OPPORTUNITIES FOR CORRUGATED BOARD

Polyethylene-coated corrugated board — produced on conventional corrugating equipment — is extending the usefulness of corrugated into many new packaging applications.

This unique container board has exceptional moisture and grease resistance and a glossy, non-abrasive liner surface that will not scratch or mar package contents.

Extruders who produce polyethylene-coated kraft liner board can get these extra advantages by using U.S.I. PETROTHENE® polyethylene resins:

HIGH PRODUCTION RATES—PETROTHENE resins have good drawdown properties, permit extrusion at high speeds.

EXCELLENT ADHESION — with minimum hot melt oxidation.

NO ODOR — an important consideration in many packaging applications.

Contact U.S.I. for information on PETROTHENE resins especially suited for coating kraft liner board.

Packagers are investigating polyethylene-coated corrugated board for applications like these:

Bulk shipment of meat, where moisture and grease-proof interiors reduce weight loss of the meat and keep moisture from weakening the carton.

Shipment of furniture and other hard goods, where abrasion damage from the container has been a problem.

Bulk bakery and confectionery shipments, where absence of grease-wickage makes containers suitable for reuse as point-of-sale displays.

In concrete construction forms, where the polyethylene coating acts as a release agent.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

FEELS DRY... top compatibility with FLEXOL PLASTICIZER EPO

No oily film . . . no dirt pick up. These are the big advantages CARBIDE has built into FLEXOL Plasticizer EPO.

This premium-grade, high-molecular-weight, epoxy plasticizer demonstrates its top-level compatibility in vinyls even after hundreds of hours of rigorous testing. FLEXOL EPO gives your vinyl products full sales appeal at purchase, and lasting satisfaction in use.

Only two to seven parts of FLEXOL EPO per 100 of resin are required for stabilizing purposes. For dual use as a stabilizer-plasticizer, concentrations of only 10 to 50 per cent of the total ingredients are needed. Primary plasticizers such as FLEXOL DOP can be used easily with EPO.

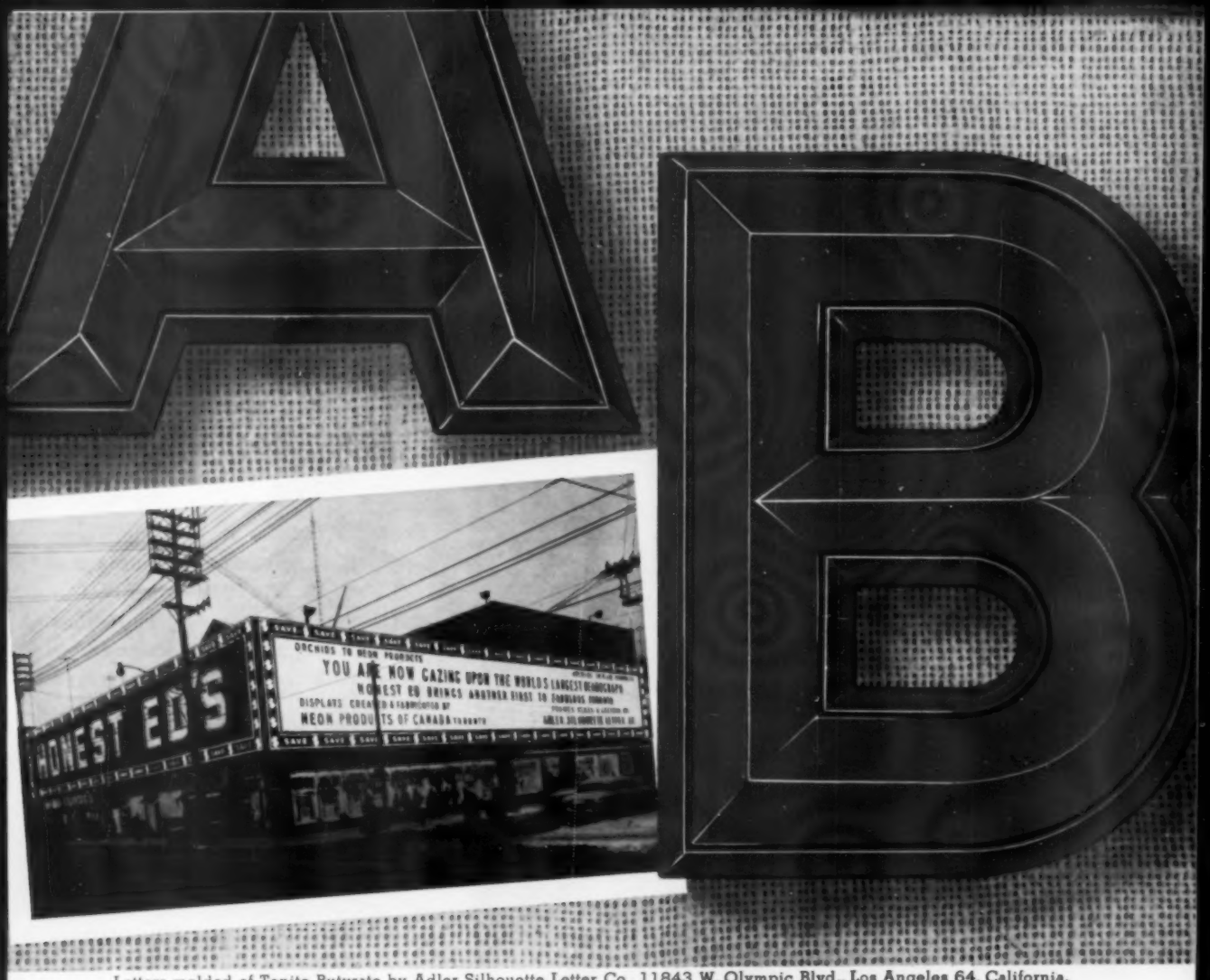
FLEXOL EPO and other members of CARBIDE's big family of vinyl plasticizers are readily available in money-saving compartment tank cars and trucks, carloads, truckloads, and drums in LCL shipments.

For prices and full specifications on FLEXOL EPO, call the CARBIDE Technical Representative in your area. Or write: Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N.Y.

FLEXOL and UNION CARBIDE are registered trade marks.

UNION CARBIDE CHEMICALS COMPANY

UNION CARBIDE



Letters molded of Tenite Butyrate by Adler Silhouette Letter Co., 11843 W. Olympic Blvd., Los Angeles 64, California.

The plastic that spells long life for changeable letters...**BUTYRATE**

Up in Toronto, you can find the world's largest changeable-letter sign, or as it's known north of the border—"readograph." The red, green, and black letters of this sign, 10,000 pounds of them, are all molded of a special weather-resistant formulation of Tenite Butyrate plastic.

As changeable displays have become increasingly popular among all types of retailers in recent years, Butyrate has become the most popular plastic changeable-letter material—*and for good reason.* Butyrate is a material whose toughness cannot be matched by any other weather-durable sign plastic. And it remains tough even in the cold weather to which this Toronto sign is sometimes exposed.

Toughness naturally is of primary concern to changeable-display customers because letters that are handled as often as once each day are sure to receive some rough treatment. Butyrate, "the tough sign plastic," has the impact resistance necessary to keep replacements at a minimum.

Molded letters are but one of many applications for Tenite Butyrate in the sign industry. Extruded sheet of this Eastman plastic is easily vacuum formed into imaginative sign faces and display elements characterized by outstanding visibility and long service life.

If you are not already familiar with the excellent outdoor performance characteristics of Tenite Butyrate—and the chance it offers you to improve the service life of outdoor products—write for further information to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE®
BUTYRATE
an Eastman plastic

Gordon M. Kline

National Bureau of Standards

STANDARDS FOR PLASTICS

International Standards for Plastics

The International Organization for Standardization (ISO) is the world's clearinghouse for the development of international standards. Organized in 1946 with headquarters in Geneva, Switzerland, its membership consists of the national standard is bodies of 44 countries. The American Standards Association, a federation consisting of 110 technical societies, trade and business associations, professional organizations, and consumers' groups, and over 2200 individual American companies, is the United States member of ISO.

The ISO conducts its standardization activities through some 100 technical committees covering the gamut of industrial materials, commodities, and equipment. The member bodies of ISO can elect to be Participating Members, Observer Members, or Nonmembers of a technical committee. The P-Member bodies designate individuals to represent them at meetings of the technical committees and to serve as members of working groups that prepare Draft Proposals for consideration by the technical committees. When a Draft Proposal is approved by the technical committee and by a majority of the participating member bodies, it becomes a Draft ISO Recommendation. It is then submitted by the ISO Secretariat in Geneva to all ISO member bodies for consideration. When it is accepted by 60 percent of the ISO member bodies voting and by the ISO Council, it becomes an ISO Recommendation; if accepted by all the ISO member bodies, it becomes an ISO Standard.

The ISO work on plastics is done by Technical Committee 61. The United States member body, the American Standards Association, is secretariat for ISO/TC 61 and as such is responsible for calling meetings of the technical committee and for processing its documents and minutes.

The first meeting of ISO/TC 61 was held in New York on September 18-19, 1951, with 7 countries (Australia, France, Netherlands, Sweden, Switzerland, United Kingdom, and United States) represented by 24 delegates (16 from U.S.); five items were dealt with at that meeting (equivalent terms, flexural properties, deflection under heat, water absorption, and conditioning and testing atmospheres). In subsequent years meetings have been held in Italy, Sweden, England, France, Netherlands, Switzerland, United States, and Germany. The latter meeting at Munich, October 26-31, 1959, was attended by 111 delegates from 18 countries; over 50 items pertaining to test methods, recommended practices for molding specimens, and nomenclature were considered by the working groups. A new working group on specifications decided to initiate work on phenolic molding compounds, rigid PVC compounds, and industrial phenolic laminates. The specifications will be limited at this stage to selection of the properties to be included and the test methods and specimens to be used to measure them; limiting values for the properties will be considered later. The next meeting of ISO/TC 61 will be held in Prague, Czechoslovakia, October 17-22, 1960.

The Participating Members of ISO/TC 61 now include 21 countries: Australia, Austria, Belgium, Czechoslovakia, Finland, France, Germany, Hungary, India, Israel, Italy, Japan, Mexico, Netherlands, Poland, Rumania, Sweden, Switzerland, USSR, United Kingdom, and United States. The Observer Members represent 14 countries: Bulgaria, Burma, Chile, Denmark, Egypt, Greece, New Zealand, Norway, Pakistan, Portugal, Spain, Turkey, Union of South Africa, and Yugoslavia.

The productivity record of ISO/TC 61 is outstanding in the ISO, according to the ISO General Secretary, Mr. Henry St. Leger. The list of ISO Recommendations and Draft Proposals for Plastics, given at the end of this report, shows that 9 ISO Recommendations have been published, and that 23 Draft ISO Recommendations are pending, of which 14 (items 10 through 23) are ready for approval by the ISO Council for publication. In addition, 6 Draft Proposals are now out for consideration by the participating member bodies for advancement to the status of Draft ISO Recommendations.

The American Standards Association relies on USANC, the U.S.A. National Committee for ISO/TC 61, for advice on technical and policy matters pertaining to the operations of the international committee on plastics. USANC is organized as Subcommittee XXI of ASTM Committee D-20 on Plastics; in addition to members of the latter committee, Subcommittee XXI includes representatives of the Manu-

facturing Chemists Association, Society of Plastics Engineers, and Society of the Plastics Industry. This tie-in with the experienced personnel of ASTM Committee D-20 is advantageous in that the ASTM methods are presented to the ISO/TC 61 working groups by individuals thoroughly conversant with the details and background of these methods; thus many ASTM methods have served as the basis for the counterpart ISO methods listed in the appendix. Conversely, the ASTM members who are participating in the activities of the ISO plastics committee are able to pass along to the D-20 sections and subcommittees information regarding the latest developments in test procedures and equipment originating in other countries.

Furthermore, the Draft ISO Recommendations are sent to letter ballot of all ASTM Committee D-20 members, thus informing them regarding the forthcoming international standards. This also provides all D-20 members with an opportunity to present their comments to USANC, which must obtain a national consenus on the proposed international standard and recommend to ASA how the U.S.A. member body shall vote on the document.

Another ISO activity of interest to the plastics industry is the work of Subcommittee 6 on Pipes and Fittings of Plastic Materials for the Transport of Fluids, which is part of ISO/TC 5 covering all types of pipes and fittings. Draft ISO Recommendation No. 282, Pipes of Plastic Materials for the Transport of Fluids, has been prepared by ISO/TC 5/SC 6. This document provides for standard external diameters in millimeters and standard nominal pressures (working pressures at 20°C.) in kgf./cm². It is intended to serve as a guide to manufacturers and users, and as a basis for specific standards for a given material or a definite field of application. The American Standards Association has been only an Observer member of ISO/TC 5/SC 6, but is now considering a change to the status of Participating Member in response to recommendations from various groups in the United States.

World progress and stability depend to an extraordinary degree on world trade. World trade, in turn, is almost wholly dependent on unified international standards. The barriers to interchange of essential goods and services between countries can be removed only if countries understand each other technically and commercially. They must speak the same language in buying, in selling, and in administering customs. The International Organization for Standardization is the place where nations meet in a cooperative effort to develop this common technical and commercial language.

Appendix

ISO Recommendations and Proposals for Plastics*

1. ISO/R 59-1958: Percentage of acetone soluble matter in phenolic moldings.
2. ISO/R 60-1958: Apparent density of molding material that can be poured from a specified funnel.
3. ISO/R 61-1958: Apparent density of molding material that cannot be poured from a specified funnel.
4. ISO/R 62-1958: Water absorption.
5. ISO/R 75-1958: Temperature of deflection under load.
6. ISO/R 117-1959: Boiling water absorption.
7. ISO/R 118-1959: Methanol-soluble matter in polystyrene.
8. ISO/R 119-1959: Free phenols in phenol-formaldehyde moldings.
9. ISO/R 120-1959: Free ammonia and ammonium compounds in phenol-formaldehyde moldings.
10. Draft ISO/DR 177: List of equivalent terms.
11. Draft ISO/DR 186: Bulk factor of molding materials.
12. Draft ISO/DR 187: Free ammonia in phenol-formaldehyde moldings (qualitative method).
13. Draft ISO/DR 188: Percentage of styrene in polystyrene with Wijs solution.
14. Draft ISO/DR 189: Viscosity number of poly(vinyl chloride) resin in solution.
15. Draft ISO/DR 190: Resistance of plastics to chemical substances.
16. Draft ISO/DR 191: Loss of plasticizers by the activated carbon method.
17. Draft ISO/DR 192: Migration of plasticizers.
18. Draft ISO/DR 193: Flexural properties of rigid plastics.
19. Draft ISO/DR 213: Charpy impact resistance of rigid plastics.
20. Draft ISO/DR 214: Izod impact resistance of rigid plastics.
21. Draft ISO/DR 215: Incandescence resistance of rigid self-extinquishing thermosetting plastics.
22. Draft ISO/DR 216: Thermal stability of poly(vinyl chloride) and related copolymers and their compounds by the Congo red method.
23. Draft ISO/DR 217: Thermal stability of poly(vinyl chloride) and related copolymers and their compounds by the discoloration method. (Second Draft).
24. Draft ISO/DR 218: Bleeding of colorants.
25. Draft ISO/DR 316: Standard atmospheres for conditioning and testing plastics.
26. Draft ISO/DR 317: Melt flow index of polyethylene and polyethylene compounds.
27. Draft ISO/DR 318: Compression molding test specimens of thermoplastics.
28. Draft ISO/DR 319: Injection molding test specimens of thermoplastics.
29. Draft ISO/DR 320: Compression molding test specimens of thermosetting materials.
30. Draft ISO/DR ?: Vicat softening point.
31. Draft ISO/DR ?: Viscosity number of polyamides.
32. Draft ISO/DR ?: Acetone-soluble matter in phenolic molding materials.
33. Draft Proposal: Tensile properties.
34. Draft Proposal: Maximum temperature and time taken for temperature to rise during the setting of unsaturated polyesters.
35. Draft Proposal: Stiffness properties as a function of temperature by means of a torsion test.
36. Draft Proposal: Resistance to natural light.
37. Draft Proposal: Resistance to artificial light.
38. Draft Proposal: Changes in mechanical properties after contact with chemicals.

* Copies of published ISO Recommendations (items 1-9) can be purchased from the American Standards Association for a nominal sum, dependent upon the number of pages.

edited by
Frank W. Reinhart,
National Bureau of Standards

Monsanto Polyethylene Big Batch Uniformity

cuts film extrusion scrap **50%**

Deerfield Plastic Company, Inc., Deerfield, Mass. reporting: "The unique consistency and uniformity of Monsanto Polyethylene resin has reduced extrusion scrap by 50%.

"We have reduced frequent breaks or blows, fish-eyes or jells. There are far fewer work stoppages for rethreading and machine adjustments. What's more, our uniformly high quality film means consistent converting conditions for our customers—fewer machine jam-ups, fewer rejects. Result: finer film for bags and overwraps."

Bag-to-bag, blend-to-blend uniformity characterizes the entire Monsanto line of polyethylene resins. No matter how you use polyethylene—for film extrusion, coating, or molding—you're assured of consistent processing conditions. Write to Monsanto Chemical Company, Plastics Division, Room 777, Springfield 2, Mass.

Monsanto

MONSANTO INITIATOR IN **PLASTICS**

MUEHLSTEIN

for

VIRGIN,
SECONDARY
and REPROCESSED
MOLDING POWDERS

- NYLON
- ACETATE
- POLYSTYRENE
- POLYETHYLENE
- A.B.S. COMPOUND
- POLYPROPYLENE
- BUTYRATE
- VINYL

H. MUEHLSTEIN & CO.

521 Fifth Ave. New York 17, New York

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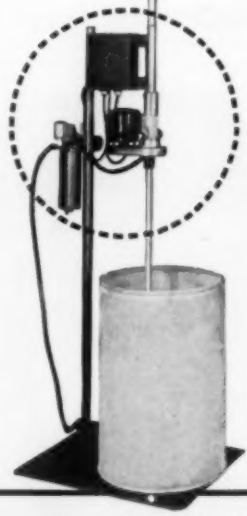
2101

WITH WHITLOCK
AUTOMATIC CONVEYORS



Pellets or re-grinds, the air controls on Whitlock automatic conveyors keep your hoppers always loaded—never over-loaded!

Model 1012 (shown above) features:

- Automatic hopper loading
- Rotating Venturi Tube for materials that tend to bridge
- Capacity up to 1,000 pounds per hour
- Self-supporting for fast, easy installation

Whitlock conveyors are available in 24 different models, pneumatic operation with automatic or manual controls, and capacities from 400 to 2,500 lbs. per hour. Write for full details.

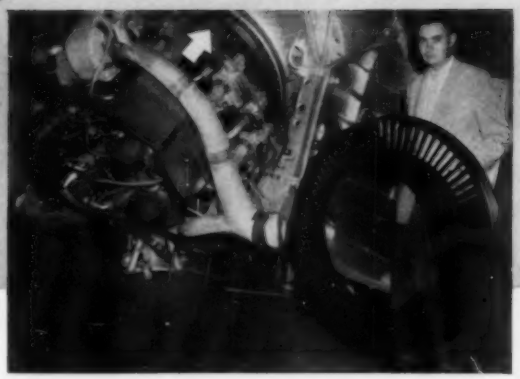
*. . . or any interval you desire.

Whitlock

60—F

WHITLOCK ASSOCIATES INC.

21655 Coolidge Hwy, Oak Park 37, Michigan



View of helicopter engine assembly shows position of contravane (arrow). In this location, the part is subjected to constant engine vibration. At right is an epoxy-glass fiber contravane, in excellent condition after 15 million cycles. It is produced for Sikorsky Aircraft, a division of United Aircraft Corporation by Hampden Brass and Aluminum Company, Fibermold Division.

GLASS-REINFORCED "BAKELITE" EPOXY RESINS

Give over 5 times longer service life to vital helicopter part

During service, the cooling air deflectors mounted directly on the engine of Sikorsky S-58 helicopters are subjected to constant engine vibration. These contravanes, traditionally made of metal, suffered extensive fatigue cracking after about 3 million cycles when operated at their resonant frequency in a test machine.

Now, contravanes made of glass fiber laminated with BAKELITE epoxy resin are being used. Why was this epoxy-glass combination selected? Because of exceptional vibration damping and fatigue resistance. Fatigue tests—like those made on the metal contravanes—showed no sign of failure at 15 million cycles. And as a bonus, the epoxy-glass part gives an 11½ per cent saving in weight.

This important new use for high-strength reinforced epoxy resin points up its outstanding potential as a structural material. For further information on BAKELITE epoxies write Dept. BM-132, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade marks of UCC.

BREEDING BETTER VINYLS EVERY DAY

There's thoroughbred performance for vinyls in those big, bright drums!

ARGUS MARK STABILIZERS give your products superior resistance to heat, cold, sulphide gases, sunlight and many other potential threats to vinyls. Mark LL is just one example. It gives vinyls *more heat and light stability (at less cost) than any other stabilizer on the market.*

ARGUS DRAPEX PLASTICIZERS also help you build in – economically – the extra measure of quality that characterizes first-rate vinyls. Drapex 4.4, for instance, gives your vinyls the performance of the finest epoxy plasticizer—and it costs you *less* than ordinary plasticizers. *Its lower specific gravity reduces volume costs by six per cent!*

If you'd like your vinyls to process better, sell faster, wear longer—check with Argus. If our research chemists don't have the answers, they'll get them! Call or write for consultation, technical bulletins, samples.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N.Y. Branch: Frederick Building, Cleveland 15, Ohio

Rep's.: H. M. Royal, Inc., 11911 Woodruff Ave., Downey, California; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal. European Affiliates: SA Argus Chemical NV; 33, Rue d'Anderlecht, Drogenbos, Belgium—Lankro Chemicals, Ltd.; Salters Lane, Eccles, Manchester, England.

SPE JOURNAL

Every Month—the *significant* NEWS
OF PLASTICS ENGINEERING

Blow Molding - An Equipment Directory

W. O. Bracken,
Hercules Powder Co.

The prospective purchaser is faced with a complexity of questions when considering blow molding equipment. The price of automatically operated integrated units (extruder, blower, compressor, control cabinet, etc.) ranges from just under $5,000 to $39,000 (special equipment for *unusually* large, blown structures are higher in cost). If tools are imported there may be about 17 per cent additional cost for duty, freight and insurance. With machines offered at various prices, the purchaser will want to study carefully engineering and design of these units. Fast cycling and continual operation are prime demands for profitable operation. Therefore, minimum maintenance characteristics and accessability to the extruder or blowing unit are compulsory.

The specification data sheets supplied by some of the machine manufacturers in many cases require further interpretation. Dry cycling time information is indicative only of potential output, and actual production seldom approaches this rate for obvious reasons. The limiting factors are primarily the cooling capacity of the blowing unit and the throughput capacity of the extrusion or injection machine. The incorporation of an accumulator in conjunction with an extruder would seem to offer appreciable increase in output together with greater versatility in control of the parison (help to minimize drawdown of the tube) particularly in heavy or lengthy shots. It has been suggested that rating of integrated units (which spells out size of extruder or other plasticizing unit) be expressed in pounds of finished item per hour with the weight of the blown object included. For example, a machine might produce 80 one-pound units, or 145 eight-ounce structures, etc., from a 2-½" extruder of given L/D ratio and horsepower.

Another area for elucidation is the interpretation of "automatic machine operation" and "postfinishing operation required". While most equipment manufacturers indicate that machines are available wherein no manual handling of the blown object is required prior to going on the printing or packing line, we feel that very few units actually are capable of this type operation. This is particularly true of the units as they are supplied currently. In view of the demand for automation, we feel certain that these refinements will be incorporated into the equipment to eliminate all manual handling for trimming, reaming, inspection, weighing, printing and packing.

Finally, no definitive statement can be made regarding the patent situation in this field. Several companies spell out patents covering this equipment and offer various licensing and royalty arrangements. Other firms state they will hold their customers free of any infringement liabilities in view of their belief that none exists. Others contend their equipment is outside existing patents and that they plan to defend their position if any legal question arises. They also feel that this position is consistent with the philosophy and practice of machine tool suppliers. Nevertheless, the whole problem is one to be considered by the molder.

Blow molding —an adolescent now—an adult tomorrow

Blow molding is in an explosive expansion stage. For example: Last May (1959) there were about 60 operations. In September of the same year, there were over 100. What are the reasons? There are several. Higher heat-resistant polymers have recently become commercially available; tools and machines are now available; and engineers in a wide variety of industries have seized on the cost reduction and novel design possibilities inherent in blow molding.

Because of the increasing importance of this process, the following equipment guide was prepared for readers of the SPE Journal. The Directory lists basic information about blow molding equipment, who makes it, where, and in most cases, how much it costs. It will serve as a starting point for those companies asking the questions " Shall we go into blow molding—and if the answer is yes, where do we get information about equipment?"

Blow Molding Equipment Manufacturers

—*American*—

Air-Formed Products Corp.
Pine Street Extension
Nashua, New Hampshire

Atlas Machine & Tool Co.
257 Hackensack St.
E. Rutherford, New Jersey

Auto-Blow Corp.
401 Bishop Ave.
Bridgeport, Conn.

Barclay Industries, Inc.
420 Lexington Ave.
New York 17, N. Y.
For
Johann Fischer, Germany

Battenfeld Corp. of America
959 W. Grace St.
Chicago 13, Illinois

Eisler Engineering Co., Inc.
760 South 13th St.
Newark 3, New Jersey

International Vulcanizing Corp.
104 Brookline Avenue
Boston 15, Mass.
For
Foster Yates & Thom, Ltd.
Blackburn, England

Kautex-U. S. Sales Co.
Downing St.
Flushing 54, N. Y.

Leedpak, Inc.
294 Fifth Avenue
New York 1, N. Y.

Modern Plastics Machinery
Lodi, New Jersey

Moslo Machinery Co.
2443 Prospect Ave.
Cleveland 15, Ohio

Newark Plastic Machinery Corp.
22 Scott St.
Newark, New Jersey

Norca Machinery Corp.
350 Fifth Avenue
New York, N. Y.

The Rainville Co.
839 Stewart Ave.
Garden City, L. I., N. Y.

John Royle & Sons
10 Essex St.
Paterson 3, New Jersey
For
Logan Engineering Co.
4901 Lawrence Avenue
Chicago 30, Illinois

F. J. Stokes Corp.
5500 Tabor Road
Phila. 20, Penna.

Watson-Stillman Press Div.
Farrel-Birmingham Co., Inc.
565 Blossom Road
Rochester 10, N. Y.

Zimmerman Machinery Co., Inc.
736 Canal St.
Stamford, Conn.

—*Foreign*—

Alpine AG.
Maschinenfabrik &
Eissengiesserei
Augsburg, Germany

Amigo Machine Co., Ltd.
16 Gorst Road
London, N. W. 10, England

Aviaplastique
11 Rue Coulaincourt
Paris 18, France

Battenfield
Maschinenfabriken GMBH
(2lb) Meinershagen-Westf.
Germany

Berliner Kunstoffe
Verarbeitung (Bekum)
Alt Lankwitz 100
Berlin-Lankwitz, Germany

Herman Berstoff
Maschinenbau-Anstalt
Hannover-Kleefeld, Germany

Granbull Tool Co., Ltd.
39 High St.
Kingston-On-Thames,
England

Industrie-Werke
Karlsruhe, Germany

Iwai & Co. Ltd.
C. P. O. Box 236
Tokyo, Japan
For
Kato Seisakusko Co. Ltd.,
Japan

Matsuda Mfg. Co. Ltd., Japan

Kleinewefers Sohne
Joh., Maschinenfabrik
Krefeld, Germany

Lavarozione Materie Plastiche
Turin, Italy

Georg Lindemann
Seit 1919
ABT 11: Spegial-
Werkyengmaschinen
Spritygussmaschinen
Postfach 172—Schoetmar—
Lippe, West Germany

Ludwig Engel
Maschinenfabrik
Schwertberg, Austria
distributed by
Dolfisco S.P.R.L.
103 Avenue de Brocqueville
Brussels, Belgium

Chemica AG.
Zurich, Switzerland

Covema s.r.l.
Via Fontana 5
Milano, Italy

China Plastics Co.
117 How Ming Street
Kun Tong, Kowloon
P. O. Box 5369
Hong Kong

P. Flesch Maschinen-Fabrik
Altenaer Strasse 10-12
Lodenscheid i. Westf.,
Germany

Machine Factory & Foundry,
Ltd.
Netstal GL.
Switzerland

Martin Rudolph
Velbert (Rhld.), Germany

MOI
Milan, Italy

Negri Bossi & C.
Via Bazzini, 24
Milano, Italy

Netstal AG.
Maschinenfabrik & Giesserei
Netstal/G1, Switzerland

Norsk Extruding
Aasheim & Rom
Notodden, Norway

Novoplast
Switzerland

Blow Mold Die Manufacturers

S.A.M.A.F.O.R.
La Courneuve/Seine, Paris

Schulte-Ultex
Arbeitsgemeinschaft
Dusseldorf, Germany

E. Shipton & Company, Ltd.
Ferndown Works
Northwood Hills
Middlesex, England

Hermann ter Hell & Co.
Gmb. H, Hamburg, Germany

Thermo Plastics Industry
Co., Ltd.
Tokyo, Japan

ToHo Kagaku Kogyo K. K.
4 Shiba Tamauracho 1-chome
Minato-Ku, Tokyo, Japan

Heinrich Wenigmann
Maschinenfabrik
Haan/Rhld, Germany

Ferriott Bros.
Magadore Avenue
Magadore, Ohio

Newark Die Co.
22 Scott St.
Newark, New Jersey

Redman Pattern Works
1215 Winchester
Kansas City, Mo.

L. J. Sommers Machine Co.
183 Front St.
Bridgeport, Conn.

Blow Molding Equipment - A DIRECTORY

COMPANY NAME:	AIR-FORMED PRODUCTS CORP.	AUTO-BLOW CORPORATION	
MODEL NUMBER:	A250-V	150-7	60-9
PRICE (WITHOUT EXTRUDER):		$22,500	$15,000
PRICE (WITH EXTRUDER):		$36,500	$24,000
BASIC OPERATION:	Extrusion plus accumulator	Extrusion	Extrusion
DRY-CYCLING TIME/HOUR:	Fast	3,600	3,600
CAPACITY LBS./HOUR:	80 plus of finished product	150	75
RATE-PIECES/HR. (RANGE):	Any multiple or fraction of above depending upon piece wt.	100-5,000	50-3,000
NO. OF PARISONS:	2, 4, or 8	2	1
MOLD PLATEN SIZES:	19½" x 17"	15" x 21½"	10" x 10"
MOVEMENT OF PLATENS:	Horizontal	Horizontal	Horizontal
MAXIMUM SIZE:	11" W x 40" L	6" O.D. x 36" L.	8" O.D. x 36" L.
MACHINE OPERATION:	Automatic, semi-automatic, manual	Manual, automatic, semi-automatic	Manual, automatic, semi-automatic
BLOW MED. TEMP. CONTROL:	No	No	No
MOLD TEMP. RANGE:		50-150°F.	50-150°F.
BLOWING METHOD:	Mandrel, needle	Mandrel	Mandrel
POSTFINISHING REQUIRED:	No	Yes	Yes
SUPPLY BLOW MOLDS:	Yes	Yes	Yes
SOLD ON ROYALTY-FREE BASIS:	Yes	Yes	Yes
PROVIDE PATENT OR LICENSE PROTECTION:	No	No	No
OVERALL SPACE REQUIREMENT:	14' x 7' x 10'	10' x 10'	
GROSS WEIGHT:	6,000 lbs.	10,000 lbs.	8,000 lbs.
POWER REQUIREMENTS:	2½" extruder, 20:1 L/D, 15 HP variable speed drive 100-150 psi air; accumulator 1½" dia., 20" stroke, 35.2 cu. in. capacity.	Air 100 psi; 220 v., 3 phase, 60 cycles; (other available) water ½" line.	
MACHINE DETAILS:		No .150-7 2½" diameter, variable screw speed up to 110 RPM. Heat electrically, water cooled, 15-20 HP motor. Continuously operated. No. 60-9 2" diameter screw, 10 HP motor, other the same.	

COMPANY NAME:	MOSLO MACHINERY COMPANY	F. J. STOKES CORPORATION
MODEL NUMBER:		
PRICE (WITHOUT EXTRUDER):		$8,000
PRICE (WITH EXTRUDER):	$27,500-$30,000	$17,500
BASIC OPERATION:	Injection	Extrusion
DRY-CYCLING TIME/HOUR:	600	900
CAPACITY LBS./HOUR:	125 +	100
RATE-PIECES/HR. (RANGE):		250-1,100
NO. OF PARISONS:	1-6	1
MOLD PLATEN SIZES:	10⅜" x 14½" x 5" thick	8" x 18"
MOVEMENT OF PLATENS:	Vertical 6"	Horizontal
MAXIMUM SIZE:	1 gal.	Up to 36" long
MACHINE OPERATION:	Manual, semi-automatic, automatic	Manual, semi-automatic, automatic
BLOW MED. TEMP. CONTROL:	Yes	No
MOLD TEMP. RANGE:	140-180	20-45°F
BLOWING METHOD:	Mandrel	Needle, mandrel, blowstick
POSTFINISHING REQUIRED:	No	No
SUPPLY BLOW MOLDS:	Yes	No
SOLD ON ROYALTY-FREE BASIS:	Yes	Yes
PROVIDE PATENT OR LICENSE PROTECTION:	No	No
OVERALL SPACE REQUIREMENT:	5' x 8'	9' x 10'
GROSS WEIGHT:	15,000 lbs.	3,500 lbs.
POWER REQUIREMENTS:	220 or 440 V., 3 phases, 60 cycles, 150 psi air	Air 100 psi, 220 V., 1 phase, 60 cycles, water.
MACHINE DETAILS:	Injection ram: 2" diameter x 8" stroke; speed 14.9 ft./min. Capacity: 4-6 oz.; injection pressure: 20,000 psi.	2½" diameter, variable speed 25-125 RPM, heat electrically, water cooled, 15 HP. Continuous or intermittent operation.

Blow Molding Equipment

COMPANY NAME:	BOSTON PLASTIC MACHINERY, INC.				EISLER ENGINEERING CO., INC.
MODEL NUMBER:	B				88-8-1X
PRICE (WITHOUT EXTRUDER):					$12,500
PRICE (WITH EXTRUDER):					Extrusion
BASIC OPERATION:	Extrusion				
DRY-CYCLING TIME/HOUR:					
CAPACITY LBS./HOUR:	To 100 lbs./hr. (high density polyethylene)				
RATE-PIECES/HR. (RANGE):	Maximum 36" long x 14" wide x 21" daylight				1,000--½ pt. units
NO. OF PARISONS:	1 or 2				
MOLD PLATEN SIZES:	300-1200				4" x 8"
MOVEMENT OF PLATENS:	Horizontal				Vertical--none; horizontal 2" each side
MAXIMUM SIZE:	128 fl. oz.				Pint
MACHINE OPERATION:	Automatic				Manual, semi-automatic, automatic
BLOW MED. TEMP. CONTROL:					
MOLD TEMP. RANGE:					
BLOWING METHOD:					Mandrel
POSTFINISHING REQUIRED:					Yes
SUPPLY BLOW MOLDS:					No
SOLD ON ROYALTY-FREE BASIS:					Yes
PROVIDE PATENT OR LICENSE PROTECTION:					
OVERALL SPACE REQUIREMENT:	7' x 4' x 6½', control cabinet 3' x 1' x 6'				8' x 8'
GROSS WEIGHT:	2,400 lbs.				3,000 lbs.
POWER REQUIREMENTS:	Air: 15 cu. ft./min., 110-200 psi main line pressure				¾ HP, 120 psi air
MACHINE DETAILS:	230 v, 3 phase, 60 cycle, 4,200 watts.				

COMPANY NAME:	KAUTEX--U. S. SALES CO.				LEEDPAK, INC.
MODEL NUMBER:	38	50	1-10	10-100	All-PAK
PRICE (WITHOUT EXTRUDER):					
PRICE (WITH EXTRUDER):	$20,500	$20,500	$26,850	$39,000	
BASIC OPERATION:	Extrusion	Extrusion	Extrusion	Extrusion	Sheet
DRY-CYCLING TIME/HOUR:	1800	1800	1800	1800	900
CAPACITY LBS./HOUR:	50	66	132	164	
RATE-PIECES/HR. (RANGE):	250-1500, or theoretically unlimited, regulated by size of piece, multiforming, etc.				1,800-9,000
NO. OF PARISONS:	1, 2 or more				Up to 10
MOLD PLATEN SIZES:	10¾"x8½"	10¾"x8½"	24" x 18"	36" x 28"	11" x 22"
MOVEMENT OF PLATENS:	Vert-Horiz.	Vert-Horiz.	Horiz.	Horiz.	Horizontal
MAXIMUM SIZE:	8 oz.	2 qts.	2½ gals.	25 gals.	Quart
MACHINE OPERATION:	Automatic	Automatic	Semi-auto.	Semi-auto.	Automatic
BLOW MED. TEMP. CONTROL:	No	No	No	No	Yes
MOLD TEMP. RANGE:	48°F. or less				100-150°F.
BLOWING METHOD:	Mandrel	Mandrel	Mandrel	Mandrel	Needle, mandrel
POSTFINISHING REQUIRED:	No	No	No	No	No
SUPPLY BLOW MOLDS:	Yes	Yes	Yes	Yes	Yes
SOLD ON ROYALTY-FREE BASIS:	Optional	Optional	Optional	Optional	No
PROVIDE PATENT OR LICENSE PROTECTION:	Optional	Optional	Optional	Optional	Yes
OVERALL SPACE REQUIREMENT:	5' x 5½'	5' x 5½'	20' x 16'		11' x 4'
GROSS WEIGHT:	3300	3300	8000	9000	2,500 lbs.
POWER REQUIREMENTS:	80 psi air	2200, 3 phase	60 cycle	¼ water line	Air 100 psi, 18 cu. ft./min. 220 V., 3 phase, 60 cycles; water: 1 gal./min.

MACHINE DETAILS:

No. 38	1½ screw (15/1) var. speed 35-90 or 75-180 continuous, 4 HP, electrically heated.
No. 50	2" screw (13.8/1), 7.5 HP, var. speed, electrically heated .
No. 1-10	Two 2" screws (13.8/1), var. speed, 75-180 RPM 7.5 HP, elec. heated.
No. 10-100	Two 2" screws (13.8/1), var. speed, 75-180" 7.5 HP, elec. heated. (Has 11-12 lbs. heated plastic storage reservoir)

- A DIRECTORY

COMPANY NAME:	MARTIN RUDOLFH				NEGRI BOSSI & CO.		
MODEL NUMBER:	B-025S	B-2	B-10	B-60	D220	S-120	S-400
PRICE (WITHOUT EXTRUDER):					$5,300	$3,700	(Under constr.)
PRICE (WITH EXTRUDER):					$9,300	$4,500	
BASIC OPERATION:	Extrusion				Extrusion	Extrusion	Extrusion
DRY-CYCLING TIME/HOUR:							
CAPACITY LBS./HOUR:							
RATE-PIECES/HR. (RANGE):	400-500	150-250	50-150	10-30	360-1,000	120-720	
NO. OF PARISONS:	1	1	1	1	1		
MOLD PLATEN SIZES:	7" x 7"	10" x 12"	10" x 16"	24" x 28"	8.7" x 8.7"		
MOVEMENT OF PLATENS:	Horizontal	Horizontal	Horizontal	Horizontal			
MAXIMUM SIZE:	16 fl. oz.	66 fl. oz.	2.6 gals.	26 gals.	67 fl. oz.	18 fl. oz.	2½ gals.
MACHINE OPERATION:	Automatic	Automatic	Automatic	Automatic	Manual, auto.	Automatic	
BLOW MED. TEMP. CONTROL:							
MOLD TEMP. RANGE:							
BLOWING METHOD:	Mandrel	Mandrel	Mandrel	Mandrel	Mandrel (2)	Mandrel (4)	
POSTFINISHING REQUIRED:	No	No	No	No			
SUPPLY BLOW MOLDS:							
SOLD ON ROYALTY-FREE BASIS:							
PROVIDE PATENT OR LICENSE PROTECTION:							
OVERALL SPACE REQUIREMENT:	4' x 4'	5' x 4'	6' x 6'	10' x 5'	10' x 10'	8.2' x 6.5'	
GROSS WEIGHT:				2,000 lbs.	10,000 lbs.	4,000 lbs.	
POWER REQUIREMENTS:					150 psi air, 35 cu.ft./min. 7 HP	150 psi, 8.8 cu.ft./min. 2.5 HP	
MACHINE DETAILS:					D220 2.362" screw, variable speed, intermittent. S-120 1.181" screw, 2.5 HP, variable speed, intermittent		

COMPANY NAME:	AMIGO MACHINE CO., LTD.	COVEMA s.r.l.
MODEL NUMBER:	Blowmaster	S.C.A.E
PRICE (WITHOUT EXTRUDER):	$7,000	$4,310
PRICE (WITH EXTRUDER):	$11,000	$6,662
BASIC OPERATION:	Extrusion	Extrusion
DRY-CYCLING TIME/HOUR:		4,800
CAPACITY LBS./HOUR:	50	20-65
RATE-PIECES/HR. (RANGE):	400-800	350-800
NO. OF PARISONS:	1	1
MOLD PLATEN SIZES:		
MOVEMENT OF PLATENS:	Horizontal	Horizontal
MAXIMUM SIZE:	20 fl. oz.	4.7" dia. x 9.8" long
MACHINE OPERATION:	Automatic	Automatic
BLOW MED. TEMP. CONTROL:		Yes
MOLD TEMP. RANGE:		
BLOWING METHOD:	Mandrel	Mandrel
POSTFINISHING REQUIRED:		Yes
SUPPLY BLOW MOLDS:		Yes
SOLD ON ROYALTY-FREE BASIS:		Yes
PROVIDE PATENT OR LICENSE PROTECTION:		Yes
OVERALL SPACE REQUIREMENT:	5' x 6'	
GROSS WEIGHT:	13,500 lbs.	1,070 lbs.
POWER REQUIREMENTS:	Air 60 psi water, 230 V., 3 phase, 50 cycle	150 psi air, 1½ cu. ft./min., water
MACHINE DETAILS:	Screw 1⅝" dia., 20-80 rpm, 5 HP motor	1¼" or 2¼" screw, variable speed avail. Electrically heated, continuous operation 4 & 8 HP motors.

Blow Molding Equipment

COMPANY NAME:	P. FLESCH MASCHINEN-FABRIK	NEWARK PLASTIC MACHINERY CORP.
MODEL NUMBER:	AFBM2	50
PRICE (WITHOUT EXTRUDER):	$4,200	$7,500
PRICE (WITH EXTRUDER):		$13,000
BASIC OPERATION:	Extrusion	Extrusion
DRY-CYCLING TIME/HOUR:	420	900-1,000
CAPACITY LBS./HOUR:		45
RATE-PIECES/HR. (RANGE):	120-400	240-720 (twin head to 1,400)
NO. OF PARISONS:		1 or 2
MOLD PLATEN SIZES:		9" x 6"
MOVEMENT OF PLATENS:	Horizontal	Horizontal
MAXIMUM SIZE:	51 fl. oz.	5" x 4" x 10" or 40 oz.
MACHINE OPERATION:	Automatic	Automatic
BLOW MED. TEMP. CONTROL:		No
MOLD TEMP. RANGE:		80-150°F.
BLOWING METHOD:	Mandrel	Mandrel (1 or 2)
POSTFINISHING REQUIRED:		No
SUPPLY BLOW MOLDS:		Yes
SOLD ON ROYALTY-FREE BASIS:		Yes
PROVIDE PATENT OR LICENSE PROTECTION:		Yes
OVERALL SPACE REQUIREMENT:	4½' x 3'	7' x 8'
GROSS WEIGHT:	1,500 lbs.	3,500 lbs.
POWER REQUIREMENTS:		60-80 psi air, 16-40 cu. ft./min.
MACHINE DETAILS:		2" screw, variable speed 10-95 RPM electrically heated, 10 HP, continuous, electrical service as required.

COMPANY NAME:	IWAI & CO. LTD. for KATO SEISAKUSKO CO., LTD.			IWAI & CO. LTD. for MATSUDA MFG. CO. LTD.				
MODEL NUMBER:	2-Mold	4-Mold	6-Mold	BME-50	SBM-30	BM-6	BM-1	SBM-1
PRICE (WITHOUT EXTRUDER):	$2,160	$3,480	$3,480			$6,830	$4,340	
PRICE (WITH EXTRUDER):	$4,060	$5,410	$5,950	$8,860	$6,190			$2,580
BASIC OPERATION:	Extrusion	Extrusion	Extrusion	Ext.	Ext.	Ext.	Ext.	Ext.
DRY-CYCLING TIME/HOUR:								
CAPACITY LBS./HOUR:		15-17 lbs.	10-12 lbs.			6 oz./ shot	1 oz./ shot	
RATE-PIECES/HR. (RANGE):	180-540	480-720	1080-1680					
NO. OF PARISONS:	1	1	1					
MOLD PLATEN SIZES:				8½" x 10½"	7" x 7½"			4" x 4"
MOVEMENT OF PLATENS:				Manual, Semi-Auto, Auto	Manual, Semi-Auto, Auto	Manual, Semi-Auto, Auto	Manual, Semi-Auto, Auto	Manual, Semi-Auto
MAXIMUM SIZE:	5½" x 11"	2½" x 6½"	1½" x 3½"					
MACHINE OPERATION:	Automatic	Automatic	Automatic					
BLOW MED. TEMP. CONTROL:								
MOLD TEMP. RANGE:								
BLOWING METHOD:								
POSTFINISHING REQUIRED:								
SUPPLY BLOW MOLDS:								
SOLD ON ROYALTY-FREE BASIS:								
PROVIDE PATENT OR LICENSE PROTECTION:								
OVERALL SPACE REQUIREMENT:	5' x 9'	7' x 6'	7' x 6'					
GROSS WEIGHT:	5,500 lbs.	4,000 lbs.	4,000 lbs.					
POWER REQUIREMENTS:	½ HP compr.	½ HP	¼ HP	½HP. Comp.	¼ HP	⅛ HP	¼ HP	⅛ HP
MACHINE DETAILS:	2-Mold 2" screw, 4 step variable, 10 HP, electrically heated. 4-Mold 2" screw, 4 speed, variable, 3 HP, electrically heated. 6-Mold 1¾" screw, 2 HP, 4 speed variable, electrically heated.			BME-50 2" screw, 5 HP motor. SBM-30 1¼" screw, 2 HP motor. BM-6 5" ram, 9" stroke, 5 HP pump, 1,000 psi, 35 gals/min. BM-1 3" ram, 6" stroke, 3 HP pump, 1,000 psi, 22 gals/min. SBM-1 5" ram, 8" stroke, 2 HP motor.				

- A DIRECTORY

COMPANY NAME:	BARCLAY INDUSTRIES, INC. for JOHANN FISCHER				THE RAINVILLE CO.
MODEL NUMBER:	BM 500	BM 500S	BM 2000	BM 5000SP	Blow-O-Matic
PRICE (WITHOUT EXTRUDER):	$7,930 Prices include Molding Mechanism, Control panel, Extrusion head & Hyd. Syst.	$8,640	$8,859	$12,720	$9,650
PRICE (WITH EXTRUDER):	$13,800 Prices include Extruder and Temperature controllers, screw, hopper, etc.	$14,800	$14,868	$20,000	
BASIC OPERATION:	Extrude Parison-Neck Up		Completely Automatic		Extrusion
DRY-CYCLING TIME/HOUR:	1 sec.	1 sec.	1 sec.	1.2 sec.	1,100
CAPACITY LBS./HOUR:	88	88	88	154	
RATE-PIECES/HR. (RANGE):	960-3800	360-1800 720-3600	100-900	120-600 240-1200	200-2,200
NO. OF PARISONS:	1	1 or 2 Optional	1	1 Optional	1 or 2
MOLD PLATEN SIZES:	5.2 x 8.7	10.3 x 8.7	10.3x11.8	12.6 x 15.8	8" x 11¼"
MOVEMENT OF PLATENS:	Hydraulic Fixed-Horiz.	Hydraulic Fixed-Horiz.	Hydraulic Mov.-Horiz.	Hydraulic Mov.-Horiz.	Vertical 10", Horizontal 12"
MAXIMUM SIZE: Dia. Length Depth Width	2.95 in. 8.7 in.	8.7 2.95x7.9 in.	4.72 in. 11.8 in.	15.8 in. 5.5 x 10 in.	5 gal.
MACHINE OPERATION:	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Automatic
BLOW MED. TEMP. CONTROL:	NORFA REGULATOR				No
MOLD TEMP. RANGE:	350 to 450 degrees F				40-90
BLOWING METHOD:	The BM 500, 500S and 2000 may be fitted for use with either mandrel or needle. The BM5000SP is equipped for use with both.				Mandrel
POSTFINISHING REQUIRED:	No	No	No	No	No
SUPPLY BLOW MOLDS:	Yes	Yes	Yes	Yes	Yes
SOLD ON ROYALTY-FREE BASIS:	Yes	Yes	Yes	Yes	No
PROVIDE PATENT OR LICENSE PROTECTION:	Not required, but any protection desired will be furnished.				Yes
OVERALL SPACE REQUIREMENT:	It is most desirable to provide 150 sq. ft. for ea. unit. Actual Floor Space–				8' x 15'
	48 sq. ft.	56 sq.ft.	63 sq.ft.	92 sq.ft.	
GROSS WEIGHT:	4,200 lbs.	5,060 lbs.	4,840 lbs.	5,940 lbs.	1,900 lbs.
POWER REQUIREMENTS:	18.2 KW	18.2 KW	18.2 KW	22 KW	Air 150 psi, 5' 3/min., 220 V., 3 phase, 60 cycles.
MACHINE DETAILS:	All models are suitable for the production of bottles with finished "neck" dimensions requiring no secondary reaming operations. All operation may be either manual or fully automatic (by selective control).				

COMPANY NAME:	NORSK EXTRUDING	THERMO PLASTICS INDUSTRY CO., LTD.	
MODEL NUMBER:		30 Hand	40 Hand
PRICE (WITHOUT EXTRUDER):	$8,000	$810	$1,090
PRICE (WITH EXTRUDER):		$1,540	$2,350
BASIC OPERATION:	Extrusion	Extrusion	
DRY-CYCLING TIME/HOUR:			
CAPACITY LBS./HOUR:		5-12	10-35
RATE-PIECES/HR. (RANGE):	350-800		
NO. OF PARISONS:	1		
MOLD PLATEN SIZES:			
MOVEMENT OF PLATENS:	Horizontal		
MAXIMUM SIZE:	1½ gal.		33 fl. oz.
MACHINE OPERATION:	Automatic	Manual	Manual
BLOW MED. TEMP. CONTROL:			
MOLD TEMP. RANGE:			
BLOWING METHOD:			
POSTFINISHING REQUIRED:			
SUPPLY BLOW MOLDS:			
SOLD ON ROYALTY-FREE BASIS:	No		
PROVIDE PATENT OR LICENSE PROTECTION:			
OVERALL SPACE REQUIREMENT:			
GROSS WEIGHT:			
POWER REQUIREMENTS:			
MACHINE DETAILS:	2½" extruder required; continuous operation.	No. 30 1¼" screw, 48-70 rpm, 1 HP, 3 phase, 4 pole. No. 40 1¾" screw, 27-70 rpm, 2 HP, 3 phase, 4 pole.	

Blow Molding-Directory—con't

COMPANY NAME:	E. SHIPTON & COMPANY, LTD.
MODEL NUMBER:	Various
PRICE (WITHOUT EXTRUDER):	
PRICE (WITH EXTRUDER):	
BASIC OPERATION:	Extrusion
DRY-CYCLING TIME/HOUR:	
CAPACITY LBS./HOUR:	60-340 lbs.
RATE-PIECES/HR. (RANGE):	
NO. OF PARISONS:	1 or 2
MOLD PLATEN SIZES:	
MOVEMENT OF PLATENS:	
MAXIMUM SIZE:	40-80 fl. oz.-15 gals.
MACHINE OPERATION:	Semi or automatic
BLOW MED. TEMP. CONTROL:	
MOLD TEMP. RANGE:	
BLOWING METHOD:	Mandrel
POSTFINISHING REQUIRED:	No
SUPPLY BLOW MOLDS:	Yes
SOLD ON ROYALTY-FREE BASIS:	
PROVIDE PATENT OR LICENSE PROTECTION:	
OVERALL SPACE REQUIREMENT:	
GROSS WEIGHT:	
POWER REQUIREMENTS:	
MACHINE DETAILS:	

What's in the Offing in Blow Molding?

What can we look forward to as logical developments in this field?

Equipmentwise, the integrated plasticizing-and-blowing mechanism will undergo extensive refinements to improve control of the parison prior to, and during the blowing step. Means to extrude (e.g., via an accumulator) heavy and/or long extruded tubes (or parallel sheets) more rapidly, with faster entrapment action to minimize stretchout and subsequent excessive wall variation in the blown structure are close at hand. Examples are an American machine now under construction to produce 15 gal. drums, weighing approximately 16 lbs., and the previously mentioned Fischer equipment.

Advances in technique to produce more complex structures, e.g., flanged and/or tapered nipples for spin-welded fitments; use of loose-insert metal plates with reverse-tapered perforations to provide anchorage to base plate for metal-metal attachment; broadening use of structural or installation inserts; and controlled variation of tube or parison wall thickness through a hydraulically-operated axial screw movement to produce relatively uniform wall in finished structure, are several such steps under way. Adiabatic extruders and "pure-shear" extruders unquestionably are being evaluated for blow molding operations. The continuous tube combined with two blowing dies which travel at same speed as extrudate and which can traverse one through the other (open) promises improved efficiency. One machinery supplier is readying an integrated line to handle feed, extrusion, blowing, trimming, unscrambling, printing, and casing of containers (4,000/hr.–$65,000). There is also a report of developments in blow molding moving toward techniques conventionally used for glass and metals where rates of 6,000 one-quart bottles/hr. are visualized. Before we get too exuberant, however, we should also understand that other container materials are not idle as evidenced by the published goal of 1,000 beer cans *per minute* the metal industry has set.

There also remains the question of which is the most desirable setup for large scale production: a single purpose, high rate, large production, expensive machine; or a multi-machine (each of relatively low production capacity) operation which may afford greater versatility and protection against complete loss of production during equipment difficulties.

As production rates step up, still further improvements over the recent advances in unscrambling, conveying, printing, filling and closing of plastics containers are being studied.

Printing is participating in this technological advance. One unit, the WIFAG offset printer, handles up to 4 colors at maximum rate of 3600/hr. Machines for silk screen printing from other firms (for cylindrical or conical shapes) handle 3 colors at 3-4,000/hr. rate. Coatings or inks which can be applied directly to untreated polyethylene surfaces are being offered, but to the writer's knowledge no completely satisfactory system is available although, again, definite progress has been made. Another process in early stages of development is a dry-offset printing pocess using thermo-diffusion dyes. At 220°F. the colorants penetrate polyolefin to a depth of 0.010". Unsatisfactory for food; at present definition is not precise.

Here is a Sample of the Potential for Blow-Molded Items in— The Automotive Industry

Vacuum cylinder for brake and shock absorber systems
Sun visor
Polish, wax, radiator cleaner, windshield cleaner, white wall cleaner, containers
Windshield cleaner solution container
Gasoline tank (design possibilities)
Glove compartment box
Air cleaner housing
Arm rests
Foot actuated bellows for windshield solution spray
Bellows for accelerator and brake pedal seals
Accordion-activated vessel systems for lubrication or other fluid discharge

—and Appliances

Air conditioner ducts
Air conditioner housings
Detergent dispensers
Refrigerator body inner liner (hinged door)
Crispers
Ice cube tray
Ice cube holder
Freezer compartment
Washer shrouds
Gear housings

The Blow Molding of Cellulosic Plastics

Blow-molded plastic bottles are the newest candidates for containers for hydrocarbons, lighter fluids, lotions, medicines, and foodstuffs

D. A. Jones and R. J. Haughwout,
Celanese Plastics Co.

The selection of a material for a blow molding application is governed by the end use to which the blown product is subjected and by the requirements necessary for the mechanical operation of forming the item.

A wide variety of formulations are available in cellulose acetate and cellulose propionate which can be tailor-made to satisfy most blow molding requirements. In addition to such properties as excellent impact strength, high tensile strength, good heat stability, dimensional stability, rigidity, and excellent surface appearance and gloss, each formulation series offers a wide selection of flow properties for ease of processing. Special acetate resins, such as flame resistant formulations can also be utilized and the majority of the resin compositions are available in transparent, translucent, and opaque colors. Cellulose propionate is also formulated to include only FDA acceptable materials and is produced in a wide range of colors including transparent.

Tables 1 and 2 present a range of many of the physical and chemical properties for cellulose acetate and propionate.

Properties of Cellulosic Bottles

Four-ounce Boston Round bottles extrusion blow molded in cellulose acetate formula XK-MH and cellulose propionate formula JMB-(H) were filled with water and conditioned for 30 minutes in water at 73°F. Six capped bottles of each material were dropped from a height of six feet onto a concrete floor until they failed. Results of these tests showed that cellulose propionate not only has a greater impact strength than acetate but also greater than the bottle grade high density polyethylenes.

Note that in cellulosic resins an increase of hardness or flow denote a decrease in plasticizer content. This causes an increase in product rigidity, permeability resistance, and melt viscosity along with a decrease in impact resistance.

Applications

The transparency and glass-like appearance of the cellulosics make them ideal materials for packaging applications as carriers for various hydrocarbons, lighter fluids, petroleum products, lotions, medicines, and foodstuffs.

The cellulosics should also find widespread use in industrial items where stiffness and transparency are essential. Christmas tree ornaments, doll bodies, and various decorative hollow ware are a few novelty items of the large number that may be blow molded.

EQUIPMENT REQUIREMENTS AND PROCESSING TECHNIQUES

The production of hollow items from the cellulosic plastics may be successfully accomplished through the use of conventional thermoplastic extrusion and blow molding equipment. The operating rates of the machines are dependent on:

(1) The flow rate or hardness of the cellulosic materials,

(2) The operating temperature and heating characteristics of the extrusion blow molding equipment,

(3) The clearance between the screw flights and cylinder wall,

(4) The screw design and dimensions,

(5) The cross-sectional area of the die orifice,

(6) The size of the final blown item.

Predrying

Since the cellulosic esters are slightly hygroscopic, they must be predried before being fed to the processing equipment. Absorbed moisture may cause a surging in the extrudate, or voids, bubbles, surface blemishes, and embrittlement in the final product.

The predrying of cellulose acetate and cellulose propionate may be accomplished by the use of circulating air ovens, infra-red lamps, or heated hopper-dryers. In the first system, the air ovens are designed to accommodate a number of shallow trays into which a layer, 1 to 2 inches in height, of the molding pellets is placed. Standard drying conditions are 2-3 hours at 160-170°F. for most acetate formulations, and 180-190°F. for cellulose propionate. These conditions may vary somewhat depending upon the relative humidity and temperature at which the pellets are stored.

Similar trays may be employed when infra-red lamps are used as a heat supply. Care should be exercised to make sure excessive heat or prolonged exposure does not melt the pellets causing them to stick together. Twenty to thirty minutes under infra-red lamps with periodic stirring should be sufficient for adequate predrying in most cases.

The hopper-dryer is quite satisfactory for continuous, long term production and consists essentially of a conical-shaped feed bin which can be attached to the extruder hopper. The bin is double-walled with an air space in between where heated air (160-190°F.) is circulated around the hopper and through the material by means of perforations in the inner wall. The hopper size should be such that it will require approximately 1-¾ hours for the pellets to flow from the top to the bottom. It is suggested that on a new start-up predried material be supplied to the hopper drier or the material should be allowed to reside in the hopper for approximately an hour before processing is begun.

The Extrusion Machine

Conventional thermoplastic extrusion machines of various L/D barrel dimension (length/diameter) employing a variety of heating systems (electrical resistance heaters, heated circulating oil, etc.) can be utilized for the satisfactory production of extrusion-blow molded items. Both short (13:1 L/D) and long (20:1 L/D) barrel extruders have been used successfully for the production of homogenous melt parisons. The longer barrel extruders offer more finite temperature control in that several heating zones are controlled independently. All investigations reported in this paper, however, were conducted on an extruder of a 13.8:1 L/D ratio which was found to be adequate for blowing applications.

In cellulosics, as well as in other thermoplastic materials, extruder screw design is a primary factor in determining material performance, output, and homogeniety. The design found to be most effective for the extrusion of both acetate and propionate is the one commonly referred to as the

Table 1. Physical Property Range of Cellulose Acetate and Cellulose Propionate

Property	Units	ASTM Method	Cellulose Acetate	Cellulose Propionate
Specific Gravity	—	D792-50	1.27-1.31	1.18-1.24
Flow Temperature	°C.	D569-48	115-185	145-183
Tensile Strength	psi.	D638-52T (0.2 in. per min.)	1300-6700	1900-5900
Elongation	%	D638-52T (0.2 in. per min.)	16-52	48-63
Flexural Strength	psi.	D790-49T	2300-11700	3300-10700
Hardness (Rockwell)	R scale	D785-51	40 to 120	—15 to 106
Impact Strength (Izod)	ft. lb./in. notch	D256-54T (73°F., ⅛" thick)	1.9-8.3	1.2-11.0
		(—40°F., ⅛" thick)	0.3-0.5	0.3-0.8
Heat Distortion Temp.	°C.	D648-45T (264 psi.)	44-78	51-70
Deformation Under Load	%	D621-51 (2000 psi.)	5-40	5-50
Water Absorption	%	D570-54T (⅛" thick)	2.1-4.2	1.6-2.0
Flammability	in./min.	D635-44	0.5-2.0	1.0-1.5
Bulk Factor	—	D392-38	2.0-2.6	1.6-2.6
Mold Shrinkage	in./in.		.003-.007	.002-.005
Index of Refraction	—	D542-50 ($n^{25}D$)	1.46-1.49	1.47-1.48
Luminous Transmittance	%	D791-54	75-95	80-90
Haze	%	D672 (⅛" thick)	3-15	5-10
Coefficient of Linear Thermal Expansion	in./in./°C.	D696-44	$8\text{-}16\times10^{-5}$	$12\text{-}16\times10^{-5}$
Thermal Conductivity	cal./sq.cm./sec./°C./cm.	C177-45T	$4\text{-}8\times10^{-4}$	$4\text{-}8\times10^{-4}$
Specific Heat	cal./gm.		0.3-0.4	0.3-0.4
Dielectric Strength	volt/mil.	D149-55T	345-365	800-1500
Volume Resistivity	ohm-cm.	D257-54T	$10^{10}\text{-}10^{13}$	$10^{12}\text{-}10^{15}$
Dielectric Constant	—	D150-54T (60 cps.)	3.5-7.5	—
		(10^3 cps.)	5.2	3.6-3.9
		(10^6 cps.)	4.5	3.0-3.5
Dissipation Factor	—	D150-54T (10^3 cps.)	0.01-0.06	0.006-0.01
		(10^6 cps.)	0.01-0.10	0.2-0.3

"vinyl" type screw. It is characterized by a constant pitch and increasing root diameter (or a decreasing channel depth).

As the pellets are conveyed by the screw, they are subjected to the heat of the barrel and to the increasing pressures due to the reductions in the channel depth and effective cross-sectional area of flow. This kneading and compressing generates additional heat due to the friction and internal working of the plastic and accelerates the melting, and thus increases the efficiency of the phase transfer of the solid pellet to the melted plastics. The pressures generated due to the reduction in flow area induce shearing and mixing actions necessary for the production of a homogenous melt. This is mandatory for good blow molding characteristics.

The channel depth differential between the feed end and the delivery end is commonly referred to as the compression ratio of the screw. Ratios of about 1.7 thru 3.5 to 1 have been found to be best suited for cellulosic extrusions.

The size of the final blown piece and the desired rate of production will determine the output required from the extruder. The screw dimension will also be dependent upon this desired output. For example, as the channel depth of the screw increases, the output increases. This is at a slight sacrifice to the production of a homogenous melt.

A breaker plate and screen pack are necessary in cellulosic extrusion to filter out any possible contaminants including large unplasticized cellulosic particles commonly referred to as gels. A screen pack containing at least one screen as fine as 100 mesh is recommended to insure elimination of these foreign particles in the final blown product.

A standard cross-head parison die with its own temperature control system is satisfactory for blow molding cellulosics. Care must be exercised to eliminate sharp or rough areas in the system where material may tend to hang up. The cellulose esters will char if exposed to high heat for a prolonged period of time, as will any thermoplastic. The flaking-off of any charred material that may be hung up in a die will result in contamination and non-uniformity in the parison extrudate and thus a possible rejection of the blown item.

A long land on the mandrel is recommended for blow molding processes where the air for forming the final product is blown down through a hollow mandrel. This longer travel of the material through the heated die bushing tends to reduce the cooling effects and weld line which result from the relatively cold air passing through and cooling the mandrel. In this latter situation, two cold fronts are set up as the material makes contact with the mandrel and travels around it, re-knitting at a point 180° from the point of entrance of the material from the extruder. This "weld" line will show up in the final product as a line running parallel to the direction of flow in the extrusion die. The longer land eliminates this defect by keeping the material in contact with a heated surface for a longer time. The added shearing action coincidental with the longer length induces greater mixing and uniformity of the extrudate.

Figure 1 depicts a typical die design of the long land type. This type of die may be employed in systems where the blowing air is introduced through the die or through an auxiliary blowing pin or hypodermic needle.

Table 2. Chemical Resistance (ASTM D543-52T)

	Effect			Effect	
	Cellulose Acetate	Cellulose Propionate		Cellulose Acetate	Cellulose Propionate
Acids			**Solvents**		
30% Sulfuric	Decomposed	No change	95% Ethyl Alcohol	Swollen-Blush	Swollen
3% Sulfuric	No change	No change	50% Ethyl Alcohol	Swollen-Blush	Sl. swollen
10% Nitric	Decomposed	Surface attacked	Acetone	Dissolved	Dissolved
5% Acetic	No change	No change	Ethyl Acetate (85-88%)	Dissolved	Dissolved
10% Hydrochloric	Decomposed	No change	Ethylene Dichloride	Dissolved	Dissolved
Oleic	No change	No change	Carbon Tetrachloride	No change or swollen	Swollen
Alkalies					
10% Sodium Hydroxide	Decomposed	Sl. surface attack	Toluene	No change or swollen	Swollen
1% Sodium Hydroxide	No change or softened	No change	Gasoline (White)	No change	No change
			Misc.		
10% Ammonium Hydroxide	Decomposed	Sl. surface attack	Water	No change	No change
2% Sodium Carbonate	No change	No change	10% Sodium-Chloride	No change	No change
—	—	—	3% Hydrogen Peroxide	Discolored	No change

Blow Molding Equipment and Molds

The cellulosic plastics may be blow molded successfully on all standard blow molding facilities offered by foreign and domestic machinery manufacturers.

Systems in which the air for forming the item is not blown through a hollow mandrel in the die head but through an auxiliary system such as a hypodermic needle or a blowing pin offer greatest ease of processing. However, with proper die design the other systems may be readily employed.

The molds necessary for blow molding the cellulosics are of the same type required for other thermoplastics. They may be machined, hobbed, or cast from such materials as aluminum, kirksite, beryllium copper, and steel.

The number of pieces to be molded, the complexity of the piece, and the personal preference of the designer will govern the final selection of the mold material.

Cast aluminum molds are normally the most economical and popular. This material is relatively soft, however, and is subject to abrasive wear at mating surface areas. Aluminum molds with steel inserts at pinch-off and threaded areas or all steel molds are recommended for long production runs.

All molds should be designed with provisions for uniformity controlling the mold temperature. This may be accomplished by drilling a series of water channels into each mold half, or by coring out the back of each mold cavity block and covering with a gasketed plate with a water inlet and outlet. A controlled mold temperature reduces the blowing cycle and produces a uniform and reproducible product surface.

Since all plastics tend to shrink in the mold while cooling, shrinkage factors must be designed into the mold to compensate for this reduction in dimension. Acetate exhibits a mold shrinkage of from 0.004 to 0.007 in./in. while cellulose propionate has a mold shrinkage of 0.002 to 0.005 in./in. depending upon the formulation and flow and molding conditions employed.

The shrinkage can be decreased somewhat by decreasing material temperature and increasing the blowing pressure.

Processing Techniques

The cellulose esters are relatively heat sensitive materials which exhibit large changes in melt viscosity with small changes in temperature. This fact indicates that a relatively narrow stock temperature range exists for the blow molding of these materials. At stock temperatures above this range, the melt viscosity becomes too low and the extruded parison tends to "neck" or draw down excessively, due to the pull of gravity. This results in items non-uniform in wall thickness from top to bottom or in a "run away" parison which cannot be blow molded. The effect of melt temperature on product weight is depicted schematically in *Figure 2*.

Faster extrusion speeds tend to minimize this necking down effect by reducing the time that the parison is stressed by its own weight. The faster rates of extrusion thus, tend to produce a heavier bottle of more uniform wall dimension. *Figure 3* illustrates the effect of extrusion speed on bottle weight.

Table 4 presents some typical data for the extrusion blow molding of acetate and propionate bottles. It should be noted that the temperatures reported here were found to be the most satisfactory for our laboratory machinery and will be slightly different for other types of equipment. Actually for each case reported, the stock temperature ranges that will permit production of satisfactory pieces are:

Acetate XK-MH	330 - 370°F.
Propionate JMB-(H)	340 - 390°F.

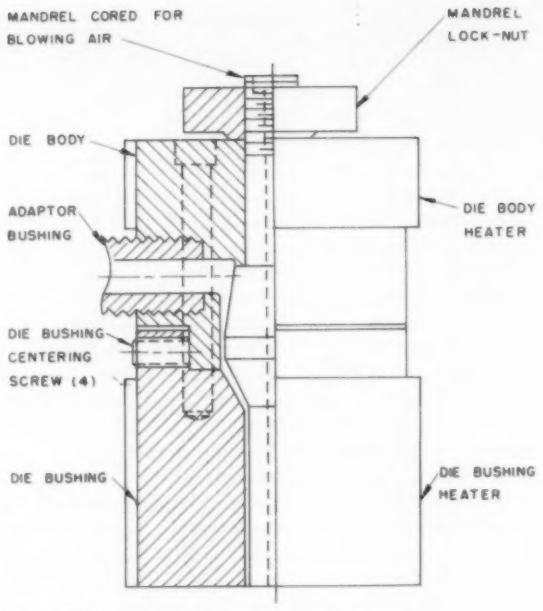


Figure 1. Typical parison cross head die.

It should be noted that harder flows (H, H_2, H_3, etc.), which contain lesser amounts of plasticizer, offer higher melt viscosities and broader processing ranges. The stock temperature, however, must be increased 5 to 10°F. for each increase in flow hardness.

A minimum flow of MH is recommended for blow molding applications. Below this flow, the melt viscosity is relatively low resulting in excessive parison neck or drawdown and

Table 3. Strength Characteristics of Plastic Bottles—Cellulose acetate and cellulose propionate bottles both possess higher burst strengths and require greater degree of vacuum for wall collapse than do polyethylene bottles of comparable wall thickness

Plastic Bottle	Burst Pressure, psig./0.001 in. wall thickness	Degree of Vacuum for Wall Collapse in. Hg/0.001 in. wall thickness
Cellulose Propionate JMB-(H) Formulation	5.0	0.39
Cellulose Acetate XK-MH Formulation	4.7	0.35
High Density Polyethylene, (0.960 Density; 0.70 M.I.)	3.3	0.33
High Density Polyethylene, Copolymer (0.950 Density; 0.20 M.I.)	2.7	0.25
High Density Polyethylene, Zeigler Type (.945 Density; 0.2 M.I.)	2.4	0.20

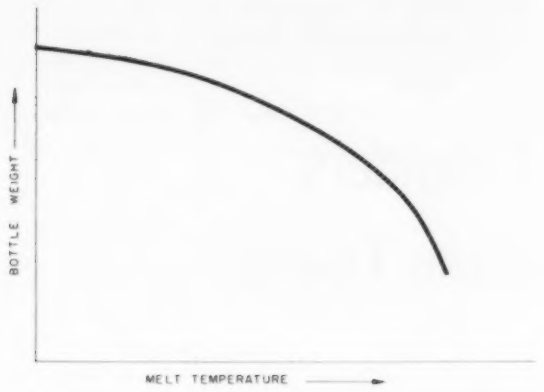


Figure 2. Effect of melt temperature on bottle weight.

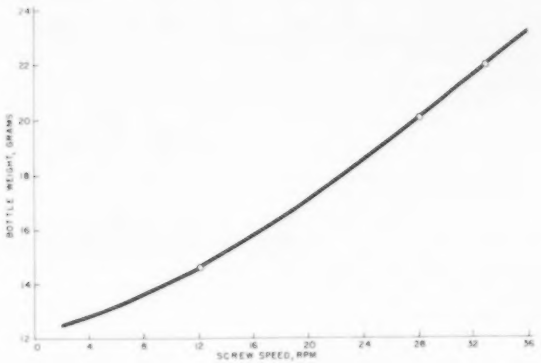


Figure 3. Effect of extrusion rate on bottle weight.

wall nonuniformity in the product. For large-sized items (12-ounce containers and larger) harder flows of higher melt strength are required.

Use of Regrinds

Since most blow molding processes produce scrap in the range of 5 to 20%, it is imperative that regrinds be used to make blow molding economical. In most operations employing the cellulosics as much as 30% scrap regrinds may be reused without any serious effect on the quality of the final product. Care, however, must be exercised in handling the scrap to prevent contamination by dust, dirt or other foreign materials which could result in rejection of the blown product.

The scrap should be reground to a uniform size, approximating that of the virgin molding pellets, and tumbled to obtain a uniform distribution of regrind and virgin materials. This is necessary to insure uniform flow properties and consistent final blown products.

The maximum amount of regrinds usable can be obtained by mixing various amounts of regrind and virgin material, blow molding a product, and determining the viscosity of this item. If this viscosity falls within the specification of the formulation used, that amount of regrind is permissible.

Post Finishing Techniques

Cellulosic plastics can be worked very much like wood and soft metals in post finishing operations. The blown items can be buffed, punched, or drilled for the removal of excess material from pinched-off regions and the blowing air entrance.

Smoother edges are obtained from punching and shearing operations if the molded piece is warmed slightly to about 125°F. Excessive speeds and pressures, however, should be avoided to prevent local overheating and gumming of the material.

Cellulosics can be decorated or labeled in assorted colors by vacuum metallizing, silk screening, hot stamping, and offset printing without any surface pretreatment.

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Table 4. Typical Processing Conditions for Cellulose Acetate and Cellulose Propionate

Material	Acetate	Propionate
Formula and Flow	XK-MH	JMB-(H)
Drying, Circulating Air Oven,		
Temp., °F.	180	180
Time, Hr.	2	2
Die—Bushing I.D., in.	0.65	0.65
Mandrel O.D., in.	0.51	0.51
Extruder; Type	2½" Hartig	2½" Hartig
Drive	7.5 HP DC Variable Drive	
L/D	13.8	13.8
Screw, Type	Constant pitch, increasing root	
Compression Ratio	3.5:1	3.5:1
Screw Cooling	Neutral	Neutral
R.P.M.	20	20
Mold, Hand Operated	4-ounce Boston Round Bottle	
Cylinder Temperatures		
Rear, °F.	350	360
Front, °F.	350	375
Collar and Adapter Temp., °F.	350	375
Die Temperature, °F.	330	360
Barrel Cooling, Hopper Zone, °F.	80	80
Blowing Air Pressure, psig.	5	5
Mold Temperature, °F.	75	75

The Use of Extenders In Flexible Urethane Foams

Thomas H. Ferrigno

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Research Division

A step forward in making cheaper foams: The use of extenders such as aluminum and magnesium silicate and calcium carbonate

From a practical standpoint, the primary advantage of extending urethane foams would be to reduce costs. Although this is a natural approach, no literature references could be found, at the time of the inception of this work, relative to the introduction of substantial quantities of filler or extender materials into any type of urethane foam. It therefore became the purpose of this work in the absence of published information to determine the effects of various comminuted solid materials on the properties of the more important flexible urethane foams.

Flexible Foam Systems

Two basic types were used; one was a prepolymer type of low viscosity, and the other a "one-shot" type. Both were based upon a polypropylene glycol of 2000 molecular weight to aid in establishing relationships between systems. In the small laboratory batches used in this study it was found that the pure 2, 4 tolylene diisocyanate provided a more uniform and more reactive prepolymer. The formulations for these systems are listed in *Tables 1 and 2*.

Extender Evaluations

In *Table 3* the results of preliminary screening tests are given. In all cases, 15 minutes after the foam had peaked, they were partially cured in the mold at 158°F for 15 minutes, removed from the mold and post-cured for 4 hours at 176°F. Particularly interesting to note is the variety of results obtained with the materials used. The 0.55 μ aluminum silicate, calcined aluminum silicate and the silica aerogel exhibited definite signs of reactivity by liberating copious volumes of carbon dioxide but producing a tough mass with large bubbles entrapped therein.

The aluminum silicates from 0.8 to 4.8 μ, silica and mica show definite promise in extending the foams but the fairly high compression sets with the silica and mica are deleterious. The surfied (surface modified) aluminum silicates, ASP's 103, 105 and 405 reveal that the alteration of the surface character of the aluminum silicate can improve or impair its properties as an extender. The 105 type of surfier (surface modifier) did improve the extension properties of the 0.55 μ aluminum silicate but it is evident that it is deleterious to compression set. The ASP 103, however, provided excellent compression set and extension properties.

Since several materials showed promise in altering the character of the foam, it was decided to investigate the possibility of surfation (surface modification) to overcome shortcomings in compression set and foam extension. The results of these investigations are listed in *Table 4*. Of specific interest was the fact that the colloidal attapulgite provided low deflection values and therefore may be useful at higher loadings without altering the properties of the unextended foam to a great extent.

The data of *Table 4* indicate that several surfied attapulgites, talc and calcium carbonate are improved by surfation. Although the same prepolymer formula was used in each case, it may be seen that considerable difficulty was experienced in obtaining uniformity from day to day and batch to batch. Rechecks of several batches indicated that uniformity was good for the runs made that day.

The results reported in *Table 4* indicate that several classes of surfier are effective in improving the properties of minerals for use as extenders. It will be noted that rechecks of several surfied attapulgites (4-3, 4-5 and 5-5) showed that they perform uniformly although the prepolymer control foams had differed in density, deflection and compression set values.

Table 1. Polyether Prepolymer

Prepolymer:		pbw
Polypropylene glycol, 2000 M. Wt.		2200
2,4 Tolylene diisocyanate first charge)		233
2,4 Tolylene diisocyanate (second charge)		664
Total		3097
Foam Formulation:		**pbw**
Prepolymer	Mix	100
DC 200 (50)	Mix	0.5
Extender	Mix	As required
Water	Mix	2.3
N-methylmorpholine	Mix	2.0

Table 2. "One-Shot" Polyether Formula

		pbw
Polypropylene glycol, 2000 M. Wt.		75.00
Triethylene diamine catalyst (Dabco)	Premix	0.54
Silicone X 520	Premix	0.54
Water	Premix	2.22
Mix above 6 seconds with high speed agitation.		
Extender (mixed until dispersed)		As required
80/20 2,4—2,6 tolylene diisocyanate		27.80
Add and mix above 6-7 seconds		
Total		106.10

Of particular interest is the influence that the surfier has upon compression set values without showing any marked effect upon deflection values. Although in most cases the compression set was reduced, surfied attapulgite 4-1 reduced this value from 21.0% for the control to 6.2%.

Surfation was also shown to improve calcium carbonate and magnesium silicate which were shown to be deleterious in *Table 3*.

In the prepolymer system it was generally found that where extension of the foam exceeded the theoretical value, the foam exhibited a larger cell structure. However, even under high magnification this was not detectable with the surfied fine particle size (0.55 μ) aluminum silicate, ASP 103.

Owing to the difficulty in hand mixing large batches, only one ¾ cubic foot foam was made. This was extended with 15% ASP 103 using the prepolymer in which it was originally tested. Its density was 3.05 pounds/cubic foot and was uniformly fine celled.

Table 5 lists the results of investigating selected extenders in "one-shot" flexible foams. Although this type formulation should yield a density of about 2 pounds per cubic foot, the 2.99 pounds density is to be expected from the small batches of this study. The compression set figures indicate that the extender has interfered with the polymerization reaction since higher loadings tend to degrade this property. Several fine particle size extenders were also used but none of these produced fully cured foams or good uniformity in cell size. The 50% deflection data of *Table 5* for the 4.8 μ aluminum silicate is plotted in *Figure 1*, where it may be

Table 3. Prepolymer Flexible Foams (10 parts extender to 100 parts prepolymer)

Extender	Lbs/ Cu.Ft.	Cu.ft/ Total Batch in Lbs.	Theoretical Total Cu.ft. (1)	psi/50% Deflection (2)	% Compression Set (3)
NONE	3.31	30.2	—	0.50	22.3
Al silicate, 0.55 μ	16.7	6.6	31.44	—	—
Al silicate, 0.8 μ	3.44	32.0	31.44	0.66	22.8
Al silicate, 1.5 μ	3.52	31.2	31.44	0.62	19.0
Al silicate, 4.8 μ	3.39	32.4	31.44	0.65	21.1
Surfied Al silicate, 0.55, μ, ASP 105	3.50	31.4	31.44	0.67	26.0
Surfied Al silicate, 4.8 μ, ASP 405	3.52	31.3	31.44	0.63	28.0
Precip. $CaCo_3$, 0.05 μ	3.56	30.9	31.40	0.57	29.5
Mg Silicate, 1.5 μ	3.89	28.3	31.32	0.58	25.0
Silica, Aerogel, 0.02 μ	no foam				
Iron Oxide, Synthetic brown	3.53	31.2	30.85	0.59	19.0
Calcined Al silicate, 1.0 μ	7.24	15.2	31.44	—	—
Cellophane (4)	3.62	29.8	32.53	—	—
Silica (5)	3.46	31.8	31.40	0.65	26.4
Mica, 5-10 μ	3.44	32.0	31.34	0.70	33.0
NONE	3.23	31.0	—	0.50	21.0
Surfied Al silicate, 0.55 μ, ASP 103	3.24	34.0	32.27	0.62	6.2
Colloidal attapulgite, Attagel 20(6)	3.87	28.4	32.26	0.41	11.5

(1) Calculated by adding the volume of extender to the volume of prepolymer; cu. ft. unextended foam + $\frac{\text{cu. ft. unextended foam x wt./gal. prepolymer}}{\text{10 x Wt./gal. Extender}}$

(2) Significant differences not shown at 25% deflection.
(3) ASTM D 1564-58T, Method B, constant deflection.
(4) ⅛" squares chopped 10 mins. in a Waring Blendor.
(5) Coarseness of 44 μ.
(6) Dried at 225°F. to less than 2% free moisture.

Table 4. Prepolymer Flexible Foams (10 parts extender to 100 parts prepolymer)

Extender		Lbs/ Cu.Ft.	Cu.ft/ Total Batch in Lbs.	Theoretical Total Cu.ft. (1)	psi/50% Deflection (2)	% Compression Set (3)
NONE		3.57	28.0	—	0.64	23.0
Surfied Attapulgite	4-3	3.73	29.5	29.20	0.71	18.2
Surfied Attapulgite	4-5	3.74	29.4	29.20	0.70	15.1
NONE		3.46	28.9	—	0.70	32.5
Surfied Attapulgite	5-5	3.58	30.7	30.14	0.67	18.9
Surfied Attapulgite	6-2	3.58	30.7	30.14	0.69	22.4
Surfied Attapulgite	8-3	3.64	30.2	30.14	0.70	23.5
NONE		3.23	31.0	—	0.50	21.0
Surfied Attapulgite	4-1	3.39	32.5	32.33	0.54	6.2
Surfied Attapulgite	5-1	3.24	34.0	32.33	0.51	24.5
Surfied Attapulgite	5-3	3.23	34.0	32.33	0.53	18.5
Surfied Attapulgite	13-3	3.37	32.6	32.33	0.48	34.0
Surfied Al, Sil, 0.55 μ	15-1	3.54	31.1	32.27	0.61	10.5
Surfied Mg Sil, 1.5 μ	13-2	3.07	35.8	32.15	0.54	12.6
Surfied $CaCO_3$	13-1	3.27	33.7	32.24	0.58	12.6
Surfied $CaCO_3$	14-1	3.28	33.6	32.21	0.60	14.8
NONE		3.30	30.2	—	0.50	22.3
Surfied Attapulgite	4-3	3.44	32.0	31.49	0.56	11.0
Surfied Attapulgite	4-5	3.49	31.5	31.49	0.60	15.0
Surfied Attapulgite	5-4	3.40	32.4	31.49	0.54	17.0
Surfied Attapulgite	5-5	3.45	31.9	31.49	0.52	17.0

(1) Calculated by adding the volume of extender to the volume of prepolymer; cu. ft. unextended foam + $\frac{\text{cu. ft. unextended foam x wt./gal. prepolymer}}{\text{10 x Wt./gal. Extender}}$

(2) Significant differences not shown at 25% deflection.
(3) ASTM D 1564-58T, Method B, constant deflection.

Table 5. "One-Shot" Polyether Foams

Extender	pbw Extender added (4)	Lbs/ Cu.ft.	cu.ft/ Total Batch in Lbs.	Theoretical Total cu.ft.(1)	psi/50% Deflection (2)	% Comp. Set (3)
NONE	—	2.99	34.4	—	0.58	9.8
Al Silicate, 4.8 μ	75	8.58	20.7	—	—	—
Al Silicate, 4.8 μ	60	4.82	33.8	—	1.12	18.9
Al Silicate 4.8 μ	45	3.97	37.2	40.52	0.92	13.6
Al Silicate, 4.8 μ	30	3.46	38.4	38.48	0.76	12.4
Al Silicate, 4.8 μ	15	2.96	39.8	36.45	0.46	15.1
Surfied Al Sil, 4.8 μ, ASP 403	60	6.12	26.6	—	1.80	22.5
Surfied Al Sil, 4.8 μ, ASP 405	45	4.05	36.5	40.52	1.13	9.9

(1) Calculated by adding the volume of extender to the volume of prepolymer; cu. ft. unextended foam + $\frac{\text{cu. ft. unextended foam x wt./gal. prepolymer}}{\text{10 x Wt./gal. Extender}}$

(2) Significant differences not shown at 25% deflection

(3) ASTM D 1564-58T, Method B, constant deflection.

(4) Parts by weight extender added to 106 parts control foam formulation.

seen that the deflection varies directly as the extender loading.

Table 6 lists the effects of several extenders upon the viscosity and stability of the polyether prepolymer. Since all minerals contain a surface layer of adsorbed water, it is evident that the apparent reactivity which is shown as a gain in viscosity is largely attributable to water-isocyanate reaction. The stability of the 4.8 μ aluminum silicate is seen to be exceptional although the surfied 0.55 μ aluminum silicate, ASP 103, is very nearly equal. The catalytic effect of the calcium carbonate is very evident for the fine particle size grade and the coarser variety provides poor suspension properties. Surfation of the 0.55 μ aluminum silicate has improved its stability besides making it a very effective extender. Apparently the attapulgite, due to its highly active surface, is still reactive with the prepolymer over a period of time, even though surfation has made it an effective extender.

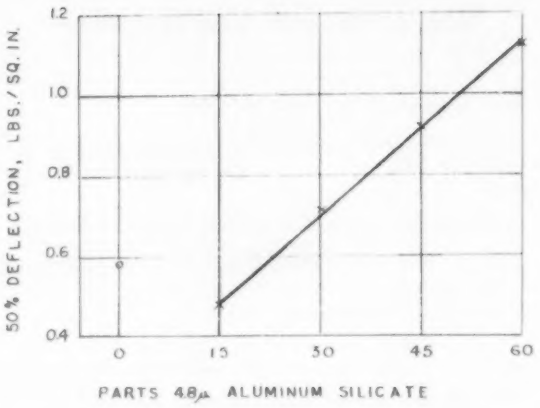

Figure 1. Loading with extender increases percent deflection.

It is interesting to note that the range of viscosities is very narrow although there is an extremely broad range of particle sizes for the extenders.

Conclusions

Various comminuted solids extend both prepolymer and "one-shot" polyether based flexible urethane foams. The 4.8 μ aluminum silicate appears to have the best properties in either system. The fine particle aluminum silicate and attapulgite are reactive in the prepolymer system; however, surfation makes both these minerals useful. Magnesium silicate and calcium carbonate are also improved by surfation.

Low concentrations of extenders favor reduced deflection values, although surfied attapulgite generally provides lower deflection values than other extenders. The volume increase resulting from the addition of extenders makes substantial cost reduction possible. Compression set properties can be vastly improved with certain surfied extenders.

It appears that only coarse extenders will be useful in the "one-shot" system since fine particle extenders tend to inhibit the polymerization reaction.

Table 6. Viscosity Stability of Selected Extenders in Polyether Prepolymer

Extender (2)	Viscosity, cps Initial	Three (1) days age	Remarks—Three days Age
None	1700		Not mixed.
None	1520	2340	Mixed 3 mins. as those samples with extender.
Aluminum Silicate, 4.8 μ	1900	3600	Uniform suspension.
Aluminum Silicate, 0.55 μ	2120	5500	Skinned.
Surfied Al Sil, 0.55 μ ASP 103	1960	3760	Slight skin.
$CaCO_3$, 0.05 μ	2180	7140	Skinned.
$CaCO_3$, 2.5 μ	1900	2900	Settled, about 10% supernatant.
Surfied Attapulgite 5-3	1980	39000	Hard settling, bubbles.
Surfied Attapulgite 8-1	2020	14020	Hard settling, bubbles.
Surfied Attapulgite 5-1	2200	86800	Gel.
Surfied Attapulgite 5-4	2500	133000	Gel.
Surfied Attapulgite 4-3	2300	52800	Hard settling, bubbles.
Synthetic brown iron oxide	1900	2920	Considerable settling.

(1) Determined at 20 rpm using the Brookfield viscometer with #5 or #7 spindles.

(2) All extenders added to prepolymer and mixed for 3 minutes at maximum speed using Lightnin' mixer with three-bladed propeller.

Applications

Isophthalic Polyester Resins

Areas of Potential for Isophthalic Polyesters:

automotive body parts
auto body putty
overlay resin in making of fiberglass boats

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In the past several years, isophthalic acid based polyester resins have become increasingly important. The purpose of this article is to point out why these resins are being used commercially, and what their actual advantages are over phthalic resins which are also widely used.

The first large volume outlet for isophthalic based polyester resins was as a preform molding resin used for molding automotive body parts. In this application, a combination of resilience at room temperature (reverse impact) and strength at elevated temperatures are required. (The reverse impact of a laminate is defined as the number of inches a ½ pound steel ball may drop without fracturing the reverse side. A 5 inch diameter ring supports the laminate, the ball falling in the center of this area.) *Table I* shows the two most important properties that must be met on this application. The reverse impact is important as obviously any automotive part must have resistance to knocks and scratches.

Flexural modulus at 180°F is important in that the formed part (fully cured) must later be subjected to a paint bake cycle in order to further finish the part. If the part after molding does not have sufficient strength at elevated temperatures, warpage, shrinkage, and other forms of distortion will occur when the part is placed in the oven. Consequently, a modulus requirement must be met.

It should be noted that Resin A (*Table 1*) will meet these two specifications of 9 inches on reverse impact and 0.5 x 10^6 on flexural modulus at 180°F. Resin-A is a resilient isophthalic polyester resin. The formulation of the panel subjected to this test is 75% resin, 25% filler, 1% catalyst; reinforced with 3 plys of 2-ounce glass mat and 1 ply of surfacing glass mat. The cure is 3 minutes at 235°F in a press. The reverse impact test is run at room temperature and the modulus test at 180°F. Resin-B in *Table I* would meet the reverse impact specification. However, it does not meet the modulus specification. This resin is the same formulation (as Resin-A) except that phthalic anhydride is substituted for isophthalic acid. It can be seen, therefore, that the isophthalic permits a greater degree of strength at elevated temperatures compared to a standard phthalic resin with the same flexibility.

Table 1. Comparison of Resilient Polyester Resins—Laminates Prepared[1] and Tested Under General Motors' Specifications

	Resin A	Resin B	Resin C
Reverse impact, inches Dropped to failure, 77°F	9 minimum	9 minimum	6 maximum
Flexural modulus, x 10^6 psi tested at 180°F (after exposure to 180°F for 30 minutes)	0.5 minimum	0.3 maximum	0.5 minimum

Resin A—Resilient isophthalic polyester resin
Resin B—Resin A with direct phthalic replacement of isophthalic
Resin C—Phthalic polyester resin reformulated from Resin B to pass flexural modulus requirements

[1] Formulation of Panels

Resin	75%
Filler	25% Surfex MM
Catalyst	1% benzoyl peroxide
Reinforcement	3 ply T-219 2-ounce mat 1 ply 20-mil surfacing mat
Cure (in press)	3 minutes at 235°F

Table 2. Comparison of Resilient Polyester Resins (2nd Formulation)—Cast Physical Properties[2]

	A.S.T.M. Test Method[3]	Resin D	Resin E
Specific gravity		1.27	1.26
Barcol hardness (Model 934-1)		37-43	40-45
Flexural strength, psi.	D-790-49T	15,000	19,000
Flexural modulus, x 10^6 psi.	D-790-49T	0.42	0.54
Tensile strength, psi.	D-638-52T	10,000	12,000
Tensile modulus, x 10^6 psi.	D-638-52T	0.42	0.51
Elongation in tension, %	D-638-52T	4.6	4.1
Compressive strength, psi.		17,000	20,000
Water absorption, %	D-570-54T	0.18	0.15
Heat distortion, 264 psi., °C	D-648-56	55-60	60-65

Resin D—Resilient type phthalic polyester resin
Resin E—Resin D prepared with isophthalic acid

[2] Cast physical properties
Catalyst: 1% benzoyl peroxide
Cure: Gel at 140°F; 1 hour at 170°F; 1 hour at 250°F

[3] Used in all indicated tests in following charts.

Table 3. Comparison of Rigid Polyester Resins—Cast Physical Properties[4]

	Resin F	Resin G
Specific gravity	1.25	1.22
Barcol	40-45	44-49
Flexural strength, psi.	14,000-18,000	17,000-20,000
Flexural modulus, x 10^6 psi.	0.58-0.62	0.57-0.63
Tensile strength, psi.	6,400-7,400	6,500-8,500
Tensile modulus, x 10^6 psi.	0.53-0.55	0.57-0.59
Elongation in tension, %	1.0-1.6	1.2-1.8
Compression, psi.	22,000-25,000	24,000-27,000
Heat distortion, 264 psi. °C	80-85	90-95

Resin F—Medium reactivity rigid molding resin—phthalic type
Resin G—Resin F formulated with isophthalic acid

[4] Cast physical properties
Catalyst: 1% benzoyl peroxide
Cure: Gel at 140°F; 1 hour at 170°F; 1 hour 250°F

Resin-C is a phthalic resin reformulated to meet the 180°F modulus specification. When it does, it becomes harder and more brittle and will fail to pass the impact test.

A further comparison of phthalic and isophthalic resins with another polyester formulation will now be made. One-eighth inch castings have been prepared from Resins-D and E, (*Table 2*) with 1% benzoyl peroxide (gelled at 140°F, post cured at 170°F and 250°F—one hour each). Inspection of the data shows that Resin-E has definite advantages over the phthalic counterpart in flexural strength, modulus, tensile strength and heat distortion. Once again the phthalic resin and isophthalic resin compared do not have the same physical properties. Resin D and E are formulations that are used in molding resins. They are not the same compositions as Resins A, B and C.

A second type of isophthalic resin is referred to as a rigid resin. This may be used once again in preform applications as discussed above. However, this type of resin does not have the resilience or the high impact strength of the previous discussed materials. This type of resin will withstand paint bake cycles, however, at elevated temperatures. This property is not found in conventional phthalic resins.

Another application is developing for isophthalic polyester resins of this type. The resin is applied by hand layup techniques or spray applications and then cured without external heat. Here the resins containing isophthalic acid offer better chemical resistance (refer to *Table 3*).

Resin G is an isophthalic resin. The major difference between the two resins in this table is heat distortion. This is quite important where molding is done at high temperatures with fast cure cycles. If the heat distortion tends to be low, tearing and other problems associated with a resin which has poor strength at elevated temperatures will be encountered.

Auto Putty Resins

Another important field where isophthalic resins are showing a distinct advantage is in body putty resins. *Table 4* is a comparison of the cast physical properties of resilient type resins for body putty. Resin H is a standard phthalic formulation. Resin I is an isophthalic formulation. The decided improvement in flexural, tensile strength, elongation and heat distortion is again noted for the isophthalic resin. However, the main advantage in dealing with isophthalic resins for a putty composition is the excellent adhesion. The adhesion to metal is exceptionally good which is something that is very important when automobile patching is being considered. Several large putty manufacturers are now using isophthalic resins exclusively.

Table 5 shows the comparison of physical properties of body putty formulations. These are filled formulations. The formulations are not described in detail as they are commercially used and have only been subjected to laboratory tests to show the advantage of the isophthalic products over the phthalic ones. Resin H is based on phthalic anhydride, Resin I is based on isophthalic acid. Note the drastic improvement in flexural strength in Resin I in formulation 1. Formulation 2 again shows the isophthalic to advantage. In formulation 3 the resins are more similar but still the isophthalic is the leader.

Another large application which has developed for isophthalic resin is as an overlay resin used in manufacture of fiberglass boats. A mold release is sprayed on the mold prior to manufacturing the boat, then a thin coating of the colored overlay is sprayed on the mold. When this material is cured sufficiently, the remainder of the resin and glass are laid up on the overlay material and cured. When the boat is released from the mold, the overlay resin is on the outside where it must withstand weathering and physical stress. For a year now, isophthalic resins have been used in the field for this purpose. One of the main advantages of the isophthalic products over the comparable phthalic materials is the ability to give the overlay material greater flexibility while still maintaining sufficient strength so that it does not crack and craze under physical or heat stress.

In spraying overlay resins, a solvent is commonly used to reduce the viscosity of the material being sprayed. If this solvent, for some reason, is not released completely from the resin before it gels, it is entrapped in the material thereby reducing the physical strength of the product. This may not show up until the boat has been in the field for months in the hot sun, then cracks may appear in the decks of the

Table 4. Comparison of Resilient Polyester Resins for Patching Compounds—Cast Physical Properties[5]

	Resin H	Resin I
Flexural strength, psi.	12,000-14,000	18,000-20,000
Flexural modulus, x 10^6 psi.	0.55-0.60	0.50-0.55
Tensile strength, psi.	6,000-8,000	11,000-13,000
Tensile modulus, x 10^6	0.55-0.60	0.44-0.47
Elongation in Tension, %	1.5%	5%
Compression, psi.	20,000-23,000	18,000-20,000
Water Absorption, % maximum	0.10	0.20
Heat distortion, 264 psi.	60-65°C	80-85°C

Resin H—Phthalic based polyester resin for body putty
Resin I—Isophthalic version of Resin H

[5] Cast physical properties
Catalyst: 1% benzoyl peroxide
Cure: Gel at 140°F
1 hour at 170°F
1 hour at 250°F

Table 5. Comparison of Semiflexible Polyester Resins—Physical Properties of Filled Mixes[6]

	Resin H	Resin I
Formulation I		
Flexural strength, psi.	4,000-6,000	6,000-8,000
Flexural modulus, x 10^6 psi.	0.6-0.7	0.8-0.9
Compression, psi.	10,000-13,000	13,000-15,000
Formulation II		
Flexural strength, psi.	5,000	7,000
Flexural modulus, x 10^6 psi.	0.9	1.0
Compression, psi.	11,500	11,500
Formulation III		
Flexural strength, psi.	5,000	6,000
Flexural modulus, x 10^6	0.7	0.7
Compression, psi.	10,000	10,000

Resin H—phthalic type polyester resin used in semiflexible putty mixes
Resin I—Isophthalic acid substituted in the same resin formulation
[6] Cured with 1% methyl ethyl ketone peroxide, gel at 77°F, 24 hours at 77°F cure before testing.

Table 6. Comparison of Overlay Base Polyester Resins—Cast Physical Properties[7]

	Resin J	Resin K
Barcol	43-50	45-50
Flexural strength	14,000	15,000
Flexural modulus	0.61	0.63
Tensile strength	8,000	10,000
Tensile modulus	0.59	0.58
Elongation in tension, %	1.5%	2.1%
Compression, psi.	23,500	24,000
Izod impact strength, ft.lbs./in. (notched)	0.285	0.500
Water absorption	0.1	0.05
Heat distortion	62°C	75°C

Resin J—Phthalic polyester resin used in formulating filled composition used for boat overlay resins. RESIN K—Isophthalic version of Resin J.

[7] Cast physical properties
Catalyst: 1% benzoyl peroxide
Cure: Gel at 140°F
1 hour at 170°F
1 hour at 250°F

boat, which of course must be repaired. It has been found, on the basis of physical tests and stress tests, that isophthalic resins will tolerate a small amount of unreacted solvents entrapped in the coating more readily than a conventional resin. Inspection of *Table 6* will show the reason for this. Resin K is the isophthalic (note the higher heat distortion and impact strength). The water absorption is low which is also important. In other words, if Resin K is contaminated with a small amount of solvent, the physical properties may be reduced to those of the phthalic resin (Resin J). However, if the phthalic resin is contaminated with solvent of any type, the heat distortion point will get in the dangerously low range.

A good test for an overlay resin is to spray it on a fin mold and lay up the part, remove it from the mold and subject it to a stress by bending in the bottom part of the fin. The stressed part is then placed in an oven at elevated temperature for 24 hours. If any stresses or weaknesses are present in the overlay material, when the part is removed from the mold, cracks will have developed in the surface coating. Isophthalic resins even when severely mistreated do not crack under this test.

Phthalic vs. Isophthalic Polyesters

The gloss on the surface coating of the boat is extremely important. One way of improving the gloss is to increase the reactivity of the resin used for preparing the overlay. In the standard phthalic resin, the gloss cannot be raised to the point where it is extremely high without encountering difficulties in getting the overlay resin too brittle. An isophthalic resin of the same reactivity as the phthalic resin will have a higher gloss. The isophthalic product will take more filler while still maintaining a high gloss. With an isophthalic product, it was not necessary to go to an acrylic type monomer to enhance the gloss. A satisfactory gloss can be attained without use of these expensive components.

Isophthalic resins are being tested extensively in the field in premix applications, as base resins for boat manufacture, and in other areas. These developments are moving at a rapid pace but the resins have not been used for a long enough time to have any long term evaluation data on them. The advantages of using isophthalic resins in molding operations, formulation of putty resins, and overlay resins have been discussed in detail. In the case of molding resins, the good hot strength properties of isophthalic resins, while maintaining good flexibility, are their prime advantage. Their ability to withstand paint bake cycles are extremely important. In body putty resins, adhesion is the big advantage of an isophthalic resin; and in overlay resins better weathering, good gloss and good handling properties are very important. The physical properties have been compared and are the reasons for these resins being better, but a table of physical properties does not tell a potential user of isophthalic resins why he should use this product. It is the end result of this improvement in physical properties that is important. If phthalic and isophthalic resins were to be compared in one sentence, it could be stated thus: Isophthalic resins have improved flexibility, improved adhesion and better hot strength properties than phthalic resins formulated in the same manner. It is impossible in many cases to manufacture a phthalic resin which will match the properties of the isophthalic product.

Epoxy-based adhesives make possible high production rates

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New Developments

Adhesives and Sealers

In order to best determine how new adhesives and sealers should be developed, it has become necessary for us to become cognizant of the needs of such specialized industries as aircraft, missiles, plastics, automotive, etc. Here an understanding of stress analysis, thermodynamics, nuclear radiation, etc. have become of prime importance. Evaluation of synthetic materials that are fresh from the status of laboratory curiosities leads to the development of new adhesives and sealers. Development of new types of application and mixing equipment, heating devices, and means of applying pressure to parts with complex contours have contributed to the widespread success of adhesive bonding and sealing operations.

Adhesives

Adhesives in Paste Form—The most recently developed paste form adhesives commercially available today include the following products:

1. A room temperature curing, two-part, 100% solids epoxy based adhesive. This product can be mixed readily in automatic metering mixing equipment. It can be quick-frozen in solvent-dry ice baths and can be stored at −40°F for extended periods of time with retention of application properties. Some of its commercial uses are in the bonding of: Aluminum to aluminum, steel to polyester laminates, polyester laminates to themselves, polyester and phenolic laminates to phenolic impregnated paper honeycomb and to polyester honeycomb.

   After a complete laboratory evaluation, this product was chosen for the bonding of reinforced polyester pontoons. In the actual production of these marine floats or pontoons, the adhesive is mixed, quick-frozen and thawed immediately prior to application to the parts. Once cured, the finished pontoons are inspected by an underwater air-pressure test.

Table 1. Room Temperature Curing Epoxy Based Adhesive Shear Strength (Alclad 2024T3 overlap bonds)

Environmental Condition	Primer	Test Temperatures −67°F.	R.T.	140°F.
Control—14 days @ R.T.	Yes	1105 psi	2845 psi	880 psi
	No	1580 psi	3080 psi	980 psi
Immersed in JP-4 fuel @ 140°F. 14 days	Yes	1756 psi	3332 psi	1106 psi
	No	1552 psi	1952 psi	504 psi
Salt spray (95°F) 14 days	Yes	1476 psi	3410 psi	984 psi
	No	1100 psi	2108 psi	598 psi
140°F, 100% R.H. for 14 days	Yes	1616 psi	3084 psi	874 psi
	No	1864 psi	2648 psi	482 psi

Table 2. Room Temperature Curing, Epoxy Adhesive Shear Strength*

Test Temperature	
−67°F	1620 psi
R.T.	1700 psi
165°F	1000 psi

* Polyester laminates reinforced with glass fabric ½" x 1" overlap bonds. Cured 7 days at room temperature

Table 3. Two Part, 150°F. Curing Epoxy Adhesive Shear Strength[1]

Test Temperature	Shear Strength Prime Alclad	Polyester
−67°F	3000 psi	2088 psi[2]
R.T.	4100 psi	2100 psi[2]
180°F	3800 psi	1743 psi[2]

[1] ½ inch x 1 inch overlap bonds Alclad 2024T3, 1 inch. Polyester reinforced with glass fabric, 1 inch x ⅛ inch.
[2] Delamination of polyester

This same room temperature curing adhesive has also lent itself to high production rates in the attachment of bonderized steel brackets to polyester cases. In this case, the adhesive is cured dielectrically using an Industrial High Frequency Dielectric Heater with a 2½ KW output (8500 B.T.U.'s/hour, operating at a frequency of 27.12 megacycles). The temperature range for bonding varies between 300-350°F.

Data on this adhesive when used to bond aluminum and glass fabric reinforced polyester to itself are found in *Tables 1 and 2* respectively.

2. Two part, 150°F curing, 100% solids, epoxy based adhesive. This product was developed to meet a general need for a 150°F curing adhesive to meet MIL-A-5090B. It is used in conjunction with a primer that requires baking. Cures are effected by heating for 2 hours at 150°F under 10 psi pressure.

   Typical test data obtained with this adhesive is tabulated in *Table 3*. Note that in the case of the polyester to polyester bonds, failure was not in the glue line, but as a delamination of the first layer of the laminated polyester.

   Possible applications of this product can be found in bonding of metals to each other, bonding of polyester to itself and in the bonding of plastic honeycomb cores to polyester or phenolic facings.

3. One part, 100% solids, heat curing epoxy based adhesive. This product was developed specifically for the missiles industry in the fabrication of missile cases where temperature requirements are 300°F. The method of using this adhesive is to coat thin-gauge, heat-resistant, high-tensile steel with the adhesive, form the part and cure in place at 350°F. This product is still under test for this application.

***Adhesives in Film Form**—Over the past 10 years many new adhesive films have been developed which are being used in the bonding of structural members of complex structures. The airframe manufacturing industry has done much to provide the necessary impetus for wide spread use of these products. Over this period of time marked increase in desire for high temperature resistance with these adhesives has been noted.*

A few recently developed products with unusual properties are discussed below:

1. Nitrile-phenolic film for use in the 500°F temperature range. This particular product is an unsupported film requiring a primed metal surface. Performance data on this adhesive film system are tabulated in *Table 4*. It should be noted that this system maintains a strength level in excess of 1,000 psi both initially and after 192 hours exposure and test at 500°F.

   It is worth noting at this time that an adhesively bonded joint using a nitrile-phenolic film of this type is used to seal the integral fuel tanks on aircraft built by one airframe manufacturer.

2. Composite film adhesives. This product is a flexible, scrim supported composite film consisting of an elastomer layer and a more rigid filleting layer. This thermosetting film is designed for high strength bonding of aluminum honeycomb components as well as metal to metal components for application requiring operational temperatures from −67°F to 200°F. A primer is necessary for metal surfaces. Typical data obtained with this adhesive system are in *Table 5*.

Table 4. Unsupported Nitrile-Phenolic Film Adhesive

Test Temperature	Shear Strength PSI
−67°F	4750 psi
77°F	4200 psi
300°F	2540 psi
350°F	2510 psi
400°F	1960 psi

Bonds were ½" x 1" overlap, Alclad 2024T3 cured 1 hr. @ 350°F, 150 psi pressure followed by 222 hrs. aging @ 300°F.

	PSI (original)	PSI (after 192 hr. @ 500°F.)
80°F	4150 psi	1560 psi
500°F	1310 psi	1130 psi
600°F	740 psi	920 psi

Bonds were ½" x 1" overlap, Stainless Steel 17-7PH TH1050, vapor honed, cured 2 hrs. @ 350°F, 150 psi pressure

Table 5. Performance of Composite Film Adhesive Aluminum to Aluminum Bond

Test	Test Temperature	Result
Overlap Shear[1]	−67°F	4460 psi
	80°F	5315 psi
	180°F	4500 psi
	250°F	950 psi
	250°F after 8 days @ 180°F	1620 psi
	250°F after 8 days @ 300°F	2000 psi
	80°F after 7 days salt spray @ 105°F	5240 psi
	80°F after 14 days salt spray @ 105°F	4630 psi
	80°F after 30 days in Skydrol 500 @ 150°F	4347 psi
	80°F after 7 days in JP-4 fuel (MIL-F 5624)	5330 psi
T-Peel (single layer of adhesive)[2]	80°F	24 lbs./inch width

[1] Overlap bonds, Alclad 2024T3, ½" x 1" bond. Cure 1 hour @ 350°F, 25 psi.
[2] Cured as [1] above. 1" x 8" x 0.020" Alclad 2024T3 panels; pulled at a 90° angle to the glue line with a jaw separation rate of 20. in./minute.

Table 6. Tensile Properties-Silicone Sealers

Test Condition	Tensile Strength (PSI) High Flow Sealer	Low Flow Sealer
14 days @ 77°F	396 psi	508 psi
7 days @ 500°F	292 psi	400 psi
14 days @ 500°F	—	425 psi
30 days @ 500°F	—	257 psi
2 days @ 600°F	400 psi	400 psi
6 days @ 600°F	568 psi	—

Table 7. Electrical Properties—Silicone Sealers

Test	High Flow Sealer	Low Flow Sealer
Arc Resistance (MIL-C-5015)		
48 hrs. @ 77°F	123 seconds	133 seconds
7 days @ 450°F	126 seconds	115 seconds
Dielectric Strength (L-P-406, Method 4031)		
48 hrs. @ 77°F	464 volts/mil	365 volts/mil
7 days @ 450°F	385 volts/mil	443 volts/mil

This composite structure was introduced to the industry to provide an easy to use honeycomb adhesive. Previously, fabricators would spread an epoxy-based paste adhesive on to an elastomeric film adhesive and then fabricate their honeycomb construction. Use of this composite film eliminates several steps in this process.

3. Scrim supported epoxy film adhesive. This newly developed film is designed for use in high strength bonding of honeycomb core to metal face sheets. In such construction this adhesive exhibits good fuel and fluid resistance as well as good strengths (2005 psi for —67°F and 2910 psi for 250°F). Figures in parenthesis are for bonding Alclad.

Sealers

As is in the case of adhesives, sealers are being sought to resist temperature in the range of 500°-1000°F. Good dielectric properties at temperature, resistance to the effects of High Energy Fuel, adhesion to new heat resistant metal alloys are additional requirements facing the sealant compounder today.

Most recent developments have been based on silicones, polysulphide, and halogenated rubbers. A few of these products are described below.

Sealers in paste form.

1. Room temperature curing silicone sealers. Sealers of this type are 100% solids materials ranging from a pourable state with a viscosity of 200-300 poises to a non-flow state of 10,000 or more poise. These materials can be cured at ambient room temperatures by addition of curing agents. Post cures at elevated temperatures produce final cures in a shorter period of time. High tensile strength both before and after extended exposure to 600°F, little or no weight and volume change after immersion in various synthetic oils, and extremely good dielectric properties are inherent characteristics of these sealants. Performance data on these sealers are shown in *Tables 6 and 7.*

2. Room temperature curing polysulphide sealers. The sealing of integral fuel tanks of jet aircraft with sealers of this type is widespread. Sealants of this class must exhibit good resistance to jet fluid containing mercaptans and disulphides. Heat limits are in the range of 250°-275°F. A recently developed sealant for this application exhibits such outstanding properties as peel strengths up to 47 pounds per inch width on Alclad, stainless steel and titanium surfaces, and elongation in excess of 700%.

3. Room temperature curing halogenated rubber sealer. Sealing materials of this type require a primer to provide good adhesion. Although this sealant does cure chemically at room temperatures, it is not a 100% solids material. Post cures at 120°F, 160°F, and 200°F as well as 350°F enhance the performance properties. Heat resistance in the range of 400°-600°F and resistance to aliphatic and aromatic fuels are important characteristics of these halogenated rubber based sealers.

Sealers in Film Form—The concept of faying surface sealing of aircraft fuel tank areas is used in the fabrication of several aircraft. Here resistance to fuel, salt water, and temperature extremes is important. Two new products designed for such use are described below.

1. Unsupported Sealant Film. This product performs well in faying surface applications because of its good flow-out under rivet pressure and good adhesion to alclad surfaces. It also has outstanding resistance to JP-4 fuels containing mercaptans and disulphides. Sealants applied in film form also offer the advantages of weight reduction, ease of application and elimination of clean-up.

2. Aluminum Foil Backed Sealant Film. This particular product is used in the aircraft industry for sealing phenolic laminate fuel cell enclosures. It has sufficient adhesion to provide a secondary seal on such enclosures but can be readily removed for inspection and/or replacement. The aluminum foil backing allows easy application to irregular surfaces. Excellent fuel resistance, good abrasion resistance and ease of application are outstanding properties of this sealant film.

Conclusion

It is not possible to describe completely each and every product available today. The intent has been to briefly describe some of the most important achievements in the adhesives and sealers industry. On the basis of these data, there is indication that we will meet the demand for high performance materials in future designs.

SPE Publications for Sale

★ **16th ANTEC Preprint Book**—Volume VI, 1960, Chicago, 83 papers. $7.50 members; $12.50 Non-members. Single preprints of individual papers, Vol. VI, while they last, $0.25 each, members; $0.40 each, non-members.

★ **1960 RETEC Preprint Book**—Plastics in the Petroleum and Chemical Industries—North Texas Section, 8 papers, 63 pages. $2.50 members, $3.75 non-members. (see program, p. 260, March 1960 SPE Journal).

Also available

★ **NATEC Preprint Book**—Volume I, 1959, Los Angeles, 20 papers. $5.00 members; $7.50 non-members (See program, September SPE Journal, page 788, and Abstracts on pages 815-817).

★ **Stability of Plastics**—Baltimore-Washington Section; Nine 1000-word abstracts. $1.00 members; $1.50 non-members (See program page 897, Oct. SPE Journal).

★ **Plastics in the Shoe Industry**—St. Louis Section, 11 papers, $3.00 members, $4.50 non-members. (See program, September SPE Journal, page 820).

★ **Plastics in Packaging**—Golden Gate Section, 12 papers, $3.00 members; $4.50 non-members. (See program, October SPE Journal, page 899).

OTHER 1959 RETEC PREPRINT BOOKS

★ **Vinyl Plastics**—Cleveland Section, 8 papers. $2.50 members; $3.75, non-members. (See program, SPE Journal, August, 1959 issue, p. 745).

★ **Plastics Finishing**—Buffalo Section, 4 papers, $2.00, members; $3.00 non-members. (See program, SPE Journal, September, 1959 issue, page 823).

★ **Encapsulation, Printed Circuits, and Fluidized Bed Processes**—Northern Indiana Section, 15 of 23 papers presented. $3.00, members; $4.50, non-members. (See program SPE Journal, April, 1959, p. 319).

★ **Plastics in the Automotive Industry**—Detroit Section, 4 papers, $2.00, members; $3.00 non-members. (See program SPE Journal, May, 1959, p. 443).

★ **A Designer's Look at Reinforced Plastics** from the Pleasure Boat; Aircraft and Missile Industries Viewpoint—North Texas Section, 6 papers. $2.00, members; $3.00, non-members. (See program SPE Journal, April, 1959, p. 324).

★ **Plastics in the Metals Industries**—Pittsburgh Section, 10 papers. $3.00, members; $4.50, non-members. (See program SPE Journal, April, 1959, p. 324).

SPE PLASTICS ENGINEERING SERIES

Vol. II—"Processing of Thermoplastic Materials", E. C. Bernhardt, Ed., Reinhold Publishing Company 1959, 705 pages. $14.40, members; $18.00, non-members.

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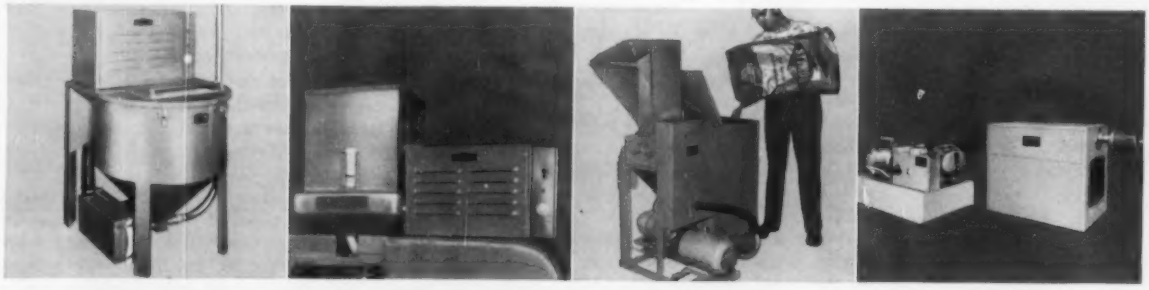

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PAG Progress

Walter A. Gammel, Sr.
Chairman, Plastics in Electrical Insulation PAG
(Walter A. Gammel, Sr. and Associates)

Plastics Team Up With Electronics

Various plastics, both thermoplastic and thermoset, play a major role in the insulation of wire, components, and assemblies in the electrical and electronic industries. Few electrical or electronic engineers are truly competent or even interested in plastics per se. They are interested only in the final results. Who then is better qualified to speak on the subject of plastics in electrical insulation than the plastics engineer with an interest and training in insulation? These are the engineers who make up the membership of the Professional Activity Group on Plastics in Electrical Insulation.

This group encourages engineers to understand the proper use of the several plastics available in order to promote the proper methods for designing and handling with the physical, chemical, and electrical parameters in mind. Members offer help to other members on solving individual and industry-wide problems. Information is distributed by means of annual meetings, Regional Technical Conferences (RETECS), PAC meetings, and by speakers on virtually any phase at local and national meetings. PAG:PEI "activities" and supports activities like the National Conference on the Application of Electrical Insulation, preparation of papers for delivery and publication, and a cooperative abstracting program.

In an economy where plastics and electronics have individually so captured public imagination as to drive many of their stocks to high price-earnings ratios (the relationship between curentt security price level and the current as well as estimated near term earnings) it is strange that plastics in electronics and the engineer working in plastics in electrical insulation has received so little effective attention by so many companies. In an era where progress in communications—from door to door, across oceans, or from a satellite whirling in space to an earthbound control station—and electronics is highly dependent upon the plastics in insulation engineer, it is even stranger.

The picture will, however, change. It will be hastened by the present business climate where (a) joint-venture may lessen the opportunity for the individual contractor, and (b) mergers occur frequently. With so few companies and individuals making use of the great potential lying in the mixed field of plastics in electronics, those who make strong technical contributions and advancements or even achievements in this particular area will enhance their own, and hence their company's opportunity for growth and a possible merger or working relationship with another concern that can be mutually beneficial.

As the picture changes, the present handicaps of time to develop the new materials that are needed, the methods of effective handling, and necessary equipment will be lifted. Time will be available to train technicians so the engineer may do his work more effectively. As the insulation engineer particularly the plastics in electrical insulation engineer emerges from behind the scenes, his place, his prestige, and his value will be increasingly recognized and rewarded.

One of the means that has been suggested to increase the professional competence of the plastics in electrical insulation engineer has been a workshop that would be given in cooperation with a leading university. As envisioned, the workshop would cover materials, design, processing, and the use of actual equipment. It is known, for example, that the quantity of high quality encapsulated coils that can be produced per unit time are related directly to the methods chosen to produce them. It is also known that most manufacturers are not taking advantage of potential savings possible. How to improve the quality of existing and design board products at low, medium, and high production levels at reduced costs with minimum expenditures would be covered. Casting under vacuum, casting under pressure, when to use an integral or throw-away mold would all be included. Terms and concepts presented would be carefully worked out, defined, and illustrated. If such a potential project is of interest to you or your associates, drop a line to Mr. A. F. Zavist, Turbine Laboratory Building 7, General Electric Company, Schenectady, New York with a copy to Dr. Richard G. Black, Materials Engineering Department, Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania. Your note should indicate why you are interested AND the part you would like to play (administration, instructor, participant, or what have you).

Mention should be made of the opportunities that some local PAC group have made of the various PAGs. For example, in Newark, Mr. Vincent Sussman and others sparked formation of local sub-committees. One of the most active is the group on Encapsulation headed by Mr. Leonard S. Buchoff, Electro-Tec Corporation, 11 Romanelli, South Hackensack, New Jersey. In time, of course, it is expected that many of these local committees will do task group work for the national PAG bodies, who, by their very nature, will become largely "reporting" on an annual basis.

Your participation in the PAG group of your choice is recommended for your own professional growth and for the satisfaction that comes from having contributed of yourself for others and our Society.

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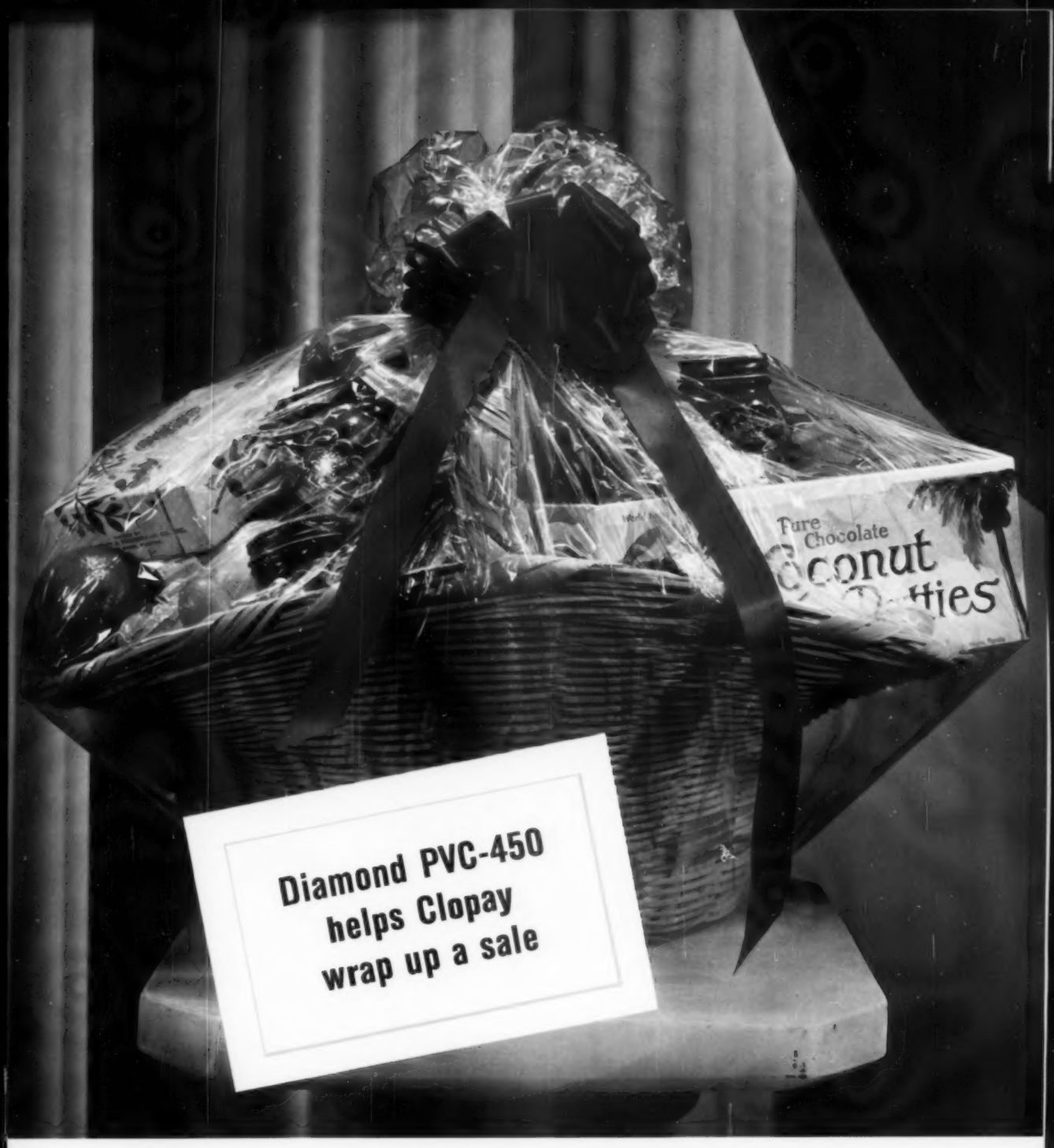
edited by
Frank W. Reynolds, *PAG Administrator*
(International Business Machines Corp.)



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SOCIETY ACTION

Mid-Year Progress Report

George W. Martin
SPE President

As we approach our administrative mid-year, it appears worthwhile to take a Society inventory to measure our progress toward our established goals, published in the February, 1960 issue of the SPE Journal. Our purpose is to commend member-groups who are meeting or exceeding their schedules and to encourage them to keep up the good work, and to stimulate those who may be lagging to accelerate their efforts.

The area of Professional Activity Groups under the administration of your First Vice-President, Frank W. Reynolds, was destined to receive major emphasis by your 1960 President from the start. We believe that this emphasis has already paid big dividends and our primary objective of making 1960 a banner year for PAGs and PACs is rapidly becoming a reality.

Frank Reynolds and his group have completed the task of revising the PAG-PAC Procedures Manual. The revised Manual was adopted by Council at its May 16th meeting in Cleveland; it will be published this summer for distribution to PAG and PAC officers.

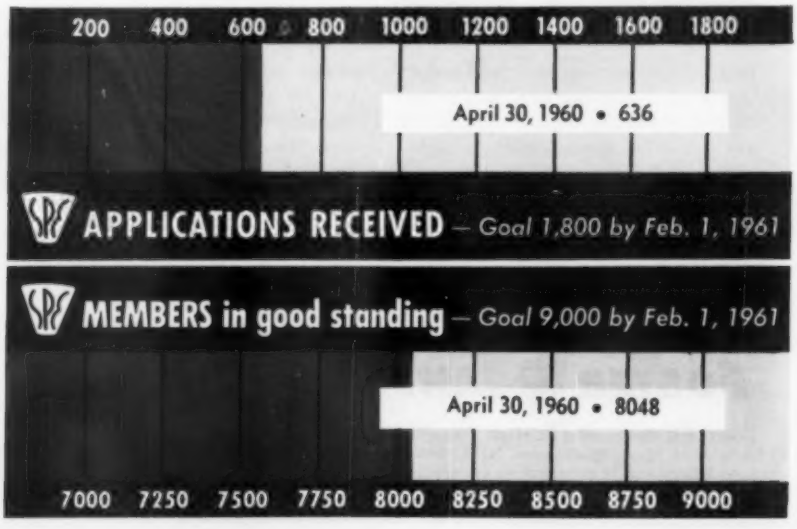
In addition, PAG is publishing an urgently needed PAG brochure to describe briefly and clearly to the SPE membership, as well as to potential members, the purpose, organization and operation of PAGs and PACs, and to define the individual member's area of participation in them. With the brochure will be mailed a simple questionnaire designed to assist PAGs to locate member-specialists qualified to participate in the various groups. I earnestly request that every member fill out and mail this questionnaire promptly when it arrives.

Section Professional Activity Committees are being formed in many of our Sections, and already are effectively influencing Section activities, particularly with regard to technical meetings programs.

Plans for the first SPE Traveling Exhibit, sponsored by our Plastics in Buildings PAG are nearing completion and the first exhibit is scheduled for early 1961. The April 1960 issue of the SPE Journal contains a fine description of this unique and constructive project.

We believe that every member of our Society could benefit himself, his Society, and his Industry by becoming a member of PAG. Also, we recommend that each of you check into the possibility of establishing Professional Activity Committees in your Section if they do not already exist. Remember, **PAG** *is* SPE.

Our Education, Inter-Society Relations, and Plastics Institute Committee activities under the Administration of SPE Second Vice-President, Haiman S. Nathan, is moving forward.



The Education Committee, at its April 23rd meeting in Columbia, S. C., completed plans for a brochure "Plastics Engineering as a Career" to be published with the assistance of the Student Membership Committee, to assist college and high school undergraduates and faculty and career advisors. This Committee is also completing a survey of courses offered in universities involving polymers, and a new index of polymer publications is being compiled. The Committee also is planning to report in October its recommendations on graduate scholarships, and is working on a revision of its Guidebook to be completed in 1961.

Our Inter-Society Relations program is proving a great asset in the area of public relations with our sister societies. This Committee is working on a new Procedures Manual that should give this important work a great deal of impetus.

The Plastics Institute Committee has developed into one of the brightest stars in the SPE constellation. If success of the Institute can be measured against the tremendous amount of effort being put forth by this Committee—then the Institute cannot miss becoming a successful reality. A good organizational job has been done, a successful press conference has been held and a research questionnaire and brochure will be distributed in June to carefully selected mailing lists.

One of the primary activities of our Meetings Committee under Frank Fine's administration is the active planning organization of the 17th ANTEC to be held in Washington, D. C. in January 1961. From all appearances, the 17th ANTEC will have a program of the highest technical quality.

The Meetings Committee is moving ahead with long-range plans to develop a central program committee to coordinate technical programming for ANTECS, RETECS, and Section Meetings. In addition, this Committee coordinates the schedule of RETECS sponsored by Sections. The first RETEC sponsored on April 20th by the North Texas Section has now become a successful part of SPE history.

This fall will prove to be very busy as we have 5 RETECS scheduled between September and November and the Committee is now engaged in developing its 1961 RETEC schedule.

Has your Section ever held a RETEC? If not, we suggest that you look into the possibilities of holding one during 1961. Any Section that has held a successful RETEC will be quick to assure you that there is no better way to promote both technical and social interests within your Section. RETECS usually increase Section membership and enhance the Section Treasury.

Maurice Malone, our 1960 Administrator of Publications, reports outstanding progress by each of his three active Committees—Publications, Technical Volumes and Editorial Advisory Board. In this area, particularly, our fine Executive Office staff in Stamford is doing a monumental job. Our SPE Journal is continuing to grow both in size and in technical quality.

Perhaps the greatest of these achievements is approval by Council, at its May 16th meeting, of a new quarterly SPE publication, devoted to plastics science and engineering, to be called "SPE Transactions". Our Technical Volumes Committee is completing plans for publication of three new volumes. Our Editorial Advisory Board has held two meetings in 1960 during which it has expanded its scope and streamlined its procedures.

Our Administrative Committees, under the administration of SPE Treasurer, Joseph B. Schmitt, is being equally productive. The Finance Committee has submitted to Council for approval the largest budget in the Society's history, totaling over $436,000.00, and has adopted a specific program to increase SPE's financial strength by increasing its reserves.

SPE's Constitution and By-Laws will be printed and distributed to sections, council and committee chairmen this summer. Our Constitution and By-Laws Committee is now preparing the necessary By-Laws and Constitution changes required to implement the new organization of the future management of the Society should it be adopted. Although some progress has been made on an adequate Public Relations program, this is an area in which more help from members of the Society is required if we are to do a job of which we can all be proud. Any member who has a flair for public relations is requested to contact us so that we can enlist him on our Public Relations Committee!

Last, but far from least, is the vital area of Sections and Membership under the able administration of SPE Secretary James R. Lampman.

When we established our goals, in January of this year, we thought that a total of 9,000 members by February 1, 1961 was an over-optimistic figure. At this sitting, it would appear probable that we will surpass this goal. Again, this is an area where each and every member of the Society can contribute effectively. Theoretically, if each member were to bring in only one new member during the year from among his business associates, we would double our membership.

In January of 1959, our master plan projected 12,000 to 14,000 members in five years—16,000 to 18,000 members in ten years. At that time, most of us suspected that these figures were ambitiously optimistic,—now we are inclined to consider them conservative. Let's prove them conservative—let's all get in and push.

Our Student Membership area is growing as far as individual Student Members are concerned. However, we are still somewhat short of our goal in organizing Student Chapters.

The Student Membership Subcommittee of the Membership Committee, working with the Education Committee, is preparing to publish a brochure on "Plastics Engineering as a Career" as reported previously.

The Credentials Committee and the New Sections Development Committee are proceeding on schedule. Our 45th and newest Section is the Arizona Section that was granted its charter at the May 16th meeting in Cleveland. The possibilities for additional overseas Sections are good, with interest now being evidenced in Australia and New Zealand.

Perhaps the most difficult and time-consuming project undertaken this year by any Committee has just been completed by the Sections Committee in developing a new up-to-date and complete Sections Procedures Manual. It should help considerably to improve communications and mutual help between Sections and the international Society.

The new Manual was approved by Council in May and will be distributed to Sections this summer. We know that it will prove a useful and essential tool of the various Section Officers and Directors. This is truly a monumental job!

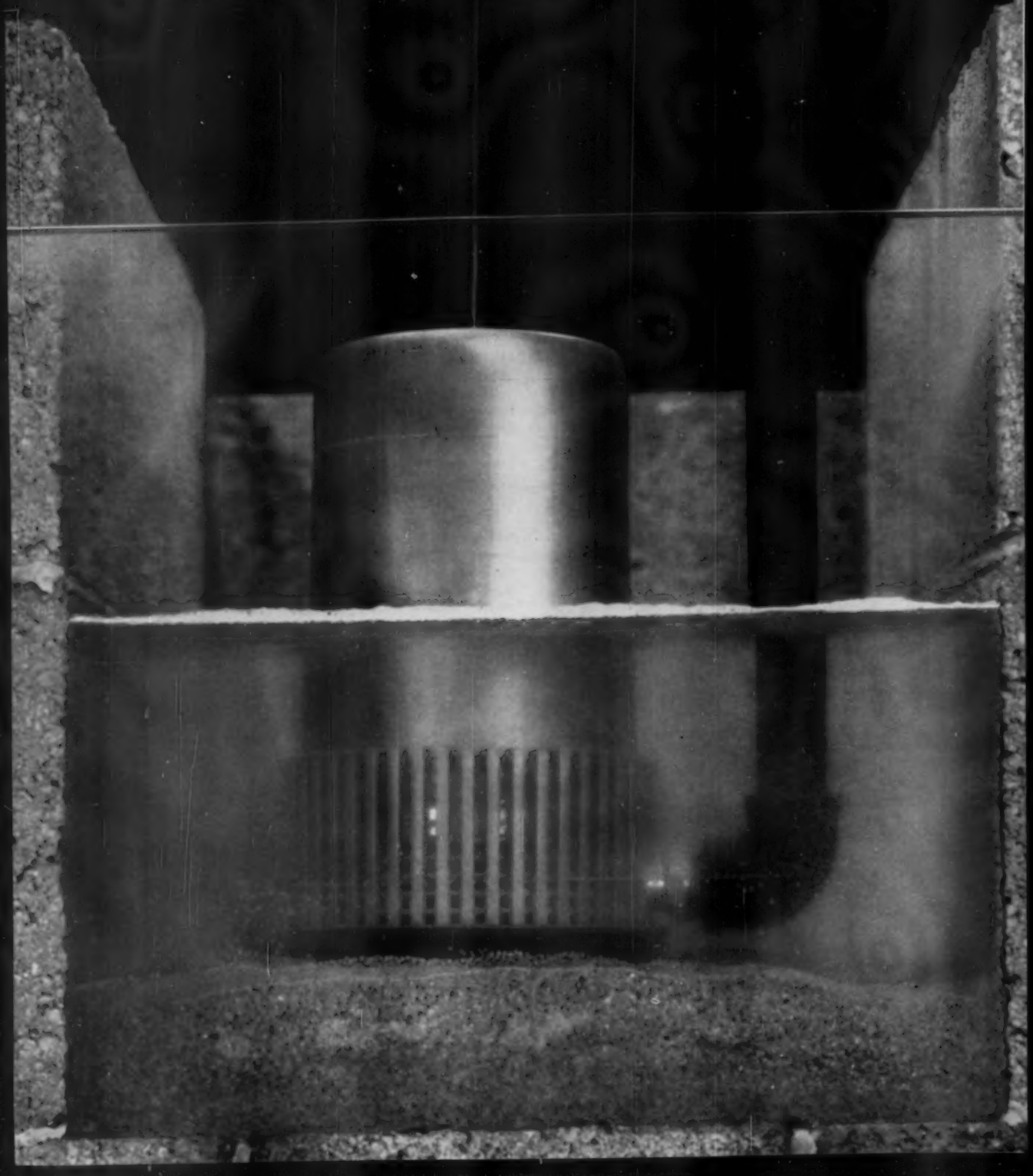
The Ad Hoc Committee on Future Organization of the Society has presented a complete plan, for organizing the future management of the society, to the May Council meeting for approval. This plan is essentially designed to separate the Technical area of the Society from the Administrative, and to streamline management operation. The rapid growth of SPE completely precludes the possibility of efficient operation under our present outmoded organization.

Although at mid-year progress looks good, we hope that you members, like ourselves, are not satisfied and will join with us to help achieve and surpass every goal.

We sincerely appreciate all of the fine co-operation that has been extended to us, and request its continuance. The result can only be better individual members, a better Society and a better Industry!

edited by **Thomas A. Bissell**
SPE Executive Secretary

CORROSION RESISTANCE...



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Properties	ASTM Test	Typical Value
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Melt Index, gm/10 min.	D 1238	2.0
Tensile Strength, psi	D 638	3,400
Elongation, %	D 638	45
Secant Modulus (Stiffness), psi	D 638	100,000
Hardness, Durometer "D"	D 676	60

Fostoria "Dynasumps", designed for rigorous underwater service, are housed in covers molded of BAKELITE Brand high-density polyethylene DMD-6001. The cover-strainers are molded by Haas Corporation, Mendon, Michigan.

DRAINAGE WATER CONTAINING harsh detergents and common corrosives can be a problem for sump pumps, but Fostoria Corporation's new submersible "Dynasump" is highly resistant to household chemicals. An integral component of this non-corrosive construction is the combination cover-strainer molded of BAKELITE high-density polyethylene DMD-6001.

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PLASTICS AROUND THE WORLD

This month's column has been made possible through the contributions of these abstracters:
Evert A. Mol (British Plastics)
Hans Mayer (Industrie Des Plastiques Modernes)
Alexander Baczewski (L'officiel des Materies Plastiques)
Alfred Alk (Poliplasti)

France

INDUSTRIE DES PLASTIQUES MODERNES

JANUARY-FEBRUARY 1960

Glass Reinforcement and the Manufacture of Pipes—(author—P. de Vinzelle)

It is pointed out that glass reinforcements in the form of cut roving or mat applied to a mandrel before application of resin will not permit the manufacture of pipes, comparable to metal pipes in strength and rigidity. Reason: The bond between glass and resin will not stand up sufficiently as long as the glass pattern consists of non-oriented cut roving.

The method described in this article is the winding of preimpregnated roving in a chosen pattern on the mandrel, the resulting product showing a greatly increased strength.

DECEMBER 1959

Use of Emulsifiable Polyethylenes in the Textile Finishing

For a number of years traditional finishing methods for textiles have been discarded in favor of application of finishes consisting of synthetic resins. Polyethylene Type A-C 629 is suitable for emulsified applications on natural and synthetic type textiles and is being used increasingly due to the protection and qualities added to the original material. The application of this finish will permit easy draping and protection against moisture. The formulation of this emulsion as well as the proper method of application are described.

The Insulation of Underground Constructions By Means Of Polyethylene Film (author—G. Coppa—Zuccari)

Complete protection of underground tunnels against the penetration of moisture through cement walls requires application of a tar type insulation on the outside of the structure which is frequently impossible to achieve. A method has been developed to accomplish this job by forming an envelope of polyethylene film outside of the walls. The methods of application and the equipment needed for the electronic heat sealing of this plastic envelope are discussed.

L'OFFICIEL DES MATERIES PLASTIQUES

OCTOBER 1959

Copolymers of Vinyl Choride—pp 1016-1034

Tables containing 287 copolymers, catalysts used, consistency of the copolymer, solubility characteristics and end uses. Lists containing 20 tripolymers and 10 copolymers manufactured in France are included.

NOVEMBER 1959

Radiation Chemistry of Macromolecules—pp 1150-1154

Two days of the International Conference on Radiation Chemistry in Geneva have been devoted to plastics. The vulcanization and the graft polymerization for various systems in the presence of Co-60 have been discussed. There have been no reports on the polymerization of gases but extended research on the polymerization of liquid ethylene has been reported. Irradiation of Nylon 66 in fiber form improves flexibility, wash resistance, flame-resistance, color stability and hand.

Mechanics of Ion-Exchange Resins—pp 1155-1159

The following types are discussed: carboxylic, mixed carboxylic-sulphonic, vinyl-aromatic phenol formaldehyde resins and membranes or papers.

Production of Plastics in Latin America

Statistics for 8 S. American countries are given.

Reinforced Polyesters and The French Polar Expeditions

Article describes manufacture of huts, weasels, and barges from polyester prefabs.

DECEMBER 1959

Macromolecular Acetals—pp 1258-1269

The chemistry of the acetal synthesis is reviewed, quoting expressly Staudingers basic work. Poly (vinyl acetals) may be elaborated from poly (vinyl alcohol) or from poly (vinyl acetate) in water or in solvent medium. Purification of the resin is important and stabilizers preventing heat yellowing are enumerated. A list of acetal manufacturers in France, Germany, USA and Great Britain follows. The largest outlet of poly (vinyl-acetals) is safety glass, followed by wirecoatings.

Applications of plastics in measurement of photoelasticity—pp 1271-1273

Several French materials are as good or better as the heretofore imported plastics used in photo elastic research. The rather new field of 3-D photo elastic experimentation and its chemical ramifications are explained.

A Solid Lubricant: Molybdenum sulfide and plastic—pp 1274-1278

A report on French and Ameircan work in combining vinyl resins, expoxies and silicones with MoS_2 in order to reduce the coefficient of friction.

Plastic Materials in Art Foundry Work

Glass reinforced polyester serves as a raw material for a gigantic

figure head adorning a tanker. Its height is 15 feet and it does not weigh more than 1500 lbs.

Substitution of Plastics for Metals, Comparison of their Mechanical Characteristics

The author who has studied this field for the French Ministry of Aviation points out that the mechanical properties of metals can be determined exactly and that these numerical values allow the prediction of their behavior. In the field of plastics on the other hand the extent of statistical spread of their mechanical constants is just as important as the constants themselves. The author proposes a logarithmic system which makes it possible to calculate the replacement of metals by plastics (nomographs, literature).

JANUARY 1960

Chemical, Physico-Chemical and Mechanical Characteristics of Plastics

A novel way of symbolizing formulae of plastic materials. Method shows how to plot simultaneously several properties of many plastics on short nomographs.

MARCH 1960

Phenol Formaldehyde Resins (author—J. C. Casanova)

Third installment of a series on small scale resin production. Article gives size of kettles and heat required.

Blow Molding of Hollow Articles (author—F. Hybre)

Double walled containers up to 50 gallons are formed from two sheets joined at the rims and blow to shape in the mold.

Italy

POLIPLASTI

JANUARY-FEBRUARY 1960

Development of the Application of Plastics in Building—pp 14-18

The author describes the wide and novel use of plastics in a housing project in Milan. Electrical switches, plugs, air conditioning ducts, louvers and other common well known applications are fundamental. Colored polyester resins are used as a matrix for varicolored pieces of marble which are subsequently ground and polished. A commercial preparation of marble chips in polyester has been developed following the excellent performance of this material in office buildings and the lobby of a large department store. Doors are made from melamine laminates on paper honeycomb cores. Polyesterglass is employed for kitchen sinks. Refuse chutes are PVC Tubing. Hoppers and access doors were added on the job by means of hot gas welding. PVC pipe is also buried in the masonry as downspouting and electrical conduit. Polyethylene and polypropylene are used in piping systems.

Gas Chromatography of Phenoplasts-Analysis of Phenolic Resins in Alcoholic Solutions

This is an analytical method of identifying free phenol and its homologues in alcoholic solutions of commercial phenolic resins by means of vapor-phase chromatography. Previous methods require laborious separations. This method gives a direct qualitative result and reproducible quantitative data of commercial quality. The procedures are described in detail and illustrated with graphs and tables.

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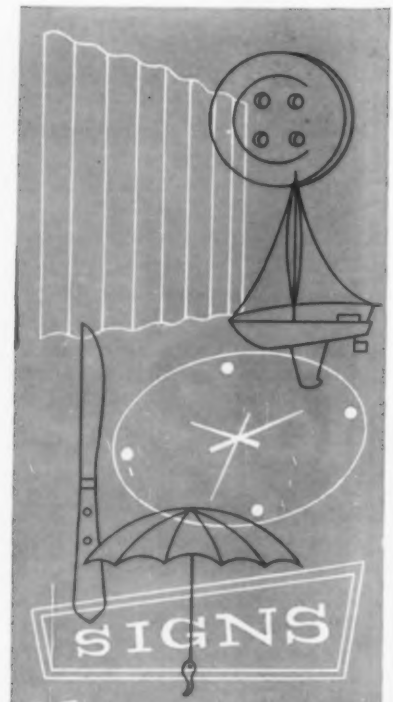

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(Continued from page 657)

Great Britain

BRITISH PLASTICS

FEBRUARY 1960

Ethylene-Butene Copolymers—pp 58-61

This article has been written by three members of the Phillips Petroleum Company, U.S.A. The article points out the good properties of the new copolymers, such as high stiffness and toughness, excellent stress cracking resistance, and superior performance under long term loads.

Polyethylene Film Coatings for Packaging—pp 62-65

The main types of multi-ply films in production are: polyethylene-coated aluminum foil, paper/aluminum foil/ polyethylene, cellulose acetate/foil/paper/polyethylene, polyethlene-coated paper, polyethylene-coated cellulose polyethylene-coated polyester, polyethylene-coated glass fabric. The major companies involved in this business are: The Metal Box Co. Ltd., The Clyde Paper Co. Ltd., Telegraph Construction & Maintenance Co. Ltd., British Cellophane Ltd., Robinson Waxed Paper Co. Ltd., and Fisher's Foils Ltd.

Overcoming Sinkage and Voids in Thick-Sections—pp 66-69

The thick-section mouldings discussed in this article are exclusively limited to shoe heels, with and without wooden inserts. The thermal behavior of the polymers, such as the change in specific volume as a function of the temperature, is discussed and related to the tendency to form sinkage and voids. The ways to eliminate these faults are discussed.

The 16% change in volume occurring with Nylon 6 melts is too large to be compensated by initial packing under high pressure. The molding technique, therefore, is different. Full gating is again the most satisfactory but pin gating can also be used. The sprues and runners should be large enough to allow the melt to remain fluid until all contraction has been compensated. There are also a number of sinkage resistant polymers available. They produce a sort of honeycomb structure inside the molding but the outside shows no sinkage. They are molded mainly by low pressure molding techniques. The mechanical strength is not seriously impaired by the large number of small voids.

TECHNICAL MEETINGS CALENDAR

17th ANTEC

Annual Technical Conference—January 24-27, 1961, Shoreham and Sheraton Park Hotels, Washington, D.C. Sponsored by the Baltimore-Washington Section. General Chairman: Dr. Gordon Kline, National Bureau of Standards, Washington, D. C.

1960 RETECS

Offers of papers in the technical area of each Regional Technical Conference are solicited by each sponsoring Section. Please submit offers and abstracts to RETEC Chairman or Section President indicated below for each RETEC:

September 8 and 9—New Horizons in Vinyl and Plastics in the Shoe Industry, Eastern New England Section, Statler-Hilton Hotel, Boston, Mass, Co-Chairman, Program, Robert Abeles, c/o Elfskin Corp., Main St., Cherry Valley, Worcester, Mass.

September 22—Plastics in Business Machines, Binghamton Section, Sheraton Inn, Binghamton, N. Y. Chairman; John E. Gwyn, c/o Consolidated Plastics, 498 Conklin Ave., Binghamton, N. Y.

October 5—Plastics in Corrosion, Golden Gate Section. Chairman: J. W. Richardson, c/o Rohm & Haas Co., 600 California St., San Francisco 8, Calif.

November 7—Automation in Injection and Compression Molding, Ontario Section; location: King Edward Sheraton Hotel, Toronto. Chairman: J. M. Lees, c/o Canadian General Electric Co., 755 Division St., North Cobourg, Ontario, Canada.

November 18—Blow Molding, Newark Section, Essex House, Newark, N. J. Chairman: Robert Hoehn, Mack Molding Co., Ryerson Ave., Wayne, N. J.

DETROIT RUBBER and PLASTIC GROUP MEETINGS

June 24—Summer Outing, Western Country Club.

OTHER MEETINGS

July 4-8—Gordon Research Conference. Polymers. Colby Junior College, New London, N. H.

July 19-21—Western Packaging & Materials Handling Exposition. Pan Pacific Auditorium, Los Angeles, Calif.

SECTION NEWS

Baltimore-Washington

Plastics in Building

STANLEY PROSEN

The May meeting was on the subject of Plastics in Building. Mr. John King, Manager of the Research Institute, National Association of Homebuilders was the speaker. A film "Research to Reality" was shown and the Section members toured the NAHB displays at that organization's housing center in Washington D. C.

Buffalo

Buffalo Discusses Polyethylene

J. P. VALENTINE

Twenty-five members and guests attended the regular monthly dinner meeting held on Monday, April 11, 1960, at the Park Lane, Buffalo, N. Y. Speakers were Mr. Peck, Technical Service, and Mr. Koch, Project Engineer, Pipe Compound, both of Semet-Solvay Division, Allied Chemical Corp., Tonawanda, N. Y. The subject was "A. C. Polyethylenes".

Mr. Peck discussed first the new A.C. Cleaning Compound, a high molecular weight polyethylene. Its function is to remove carbonized spots and semi-oxidized polymer from injection and extrusion cylinders.

Next material discussed was a high molecular weight polyethylene (ACX) for compression molding. Molded with 125 psig steam, it has good heat distortion and can be used to mold sections of varying thickness and complexity.

In the low molecular weight polyethylene polymers, the most outstanding uses include: (1) Color and odor carriers, (2) in films, to decrease the water vapor transmission rate and minimize strength directionality when added in quantities of 1 to 5% to regular film grade materials, (3) in injection molding, to be added to regular materials in small quantities for troublesome moldings.

Indianapolis

Dry Coloring of Plastics

H. H. CLAPP

The April meeting of the Central Indiana Section was held the 26th at the Continental Hotel, Indianapolis.

The technical session heard Mr. Art Cowan of Plastic Molders Supply, Inc. He has been associated with the plastic industry for the past twelve years and a member of SPE for nine years. His subject was "Dry Coloring of Plastics" and covered principles and advantages of dry coloring, special equipment necessary or desirable in molding cylinder and desirable mold features. He estimates the average cost for a range of colors for dry coloring is 1½¢ per lb. Quality has improved in recent years due to improved techniques and better pigments.

Of special note: Central Indiana Section has published Vol. 1 number 1 issue of the bulletin known as the "News Views". The editor is Brandt Beckett of Western Electric Company. Plans call for 4 issues per year.

Central Ohio

Central Ohio Tours Western Electric Plant

RICHARD SHARPE

Approximately 80 members and guests toured Western Electric's new plant at Columbus Ohio. The group viewed injection and compression molding machines, and also were shown development and manufacturing operations connected with the business of building telephone exchange and office switching gear.

Cleveland

PAG Activities

E. K. McCLELLAN

The April meeting of the SPE Cleveland Section was held on the 18th of the month at the Cleveland Engineering Society Building, Cleveland, Ohio.

There were 51 members and guests on hand to hear Mr. Frank W. Reynolds, National First Vice President, and administrator of the PAG, speak on PAG activities. After Mr. Reynolds' talk the meeting was devoted to new thermoplastic materials. Talks were given by Dr. James D. Bruton of E. I. DuPont de Nemours and Company regarding their new polymerized formaldehyde acetal resin "Delrin", and Mr. J. Y. Lomax of Hercules Powder Company, spoke on "Penton". Both talks were illustrated by the use of slides.

Connecticut

The Infinity of Plastic Mold Materials

K. G. CLARKE

The April meeting of the Connecticut Chapter of the Society of Plastics Engineers carried a double feature: Top-notch technical discussion on tool steel and a stimulating address by our Society's National President.

Guest speaker for the evening was Mr. E. E. Lull of the Crucible Steel Company, Pittsburgh, Pennsylvania, who spoke on "The Infinity of Plastic Molds Materials". Mr. Lull pointed out the many different types of steels available for mold construction. He described in detail the new numerical system for designating these various types. The effects of grain structure and imperfections in stock on tooling problems was also elaborated upon. Major emphasis should be placed on selecting the correct steel for each individual tooling job, according to Mr. Lull.

The Section was also honored by a talk describing the aims and objectives of the SPE by Mr. George Martin, our National President, President and General Manager of Holyoke Plastics Company, Holyoke, Massachusetts.

Milwaukee

Reinforced Molding Compounds

C. H. STRONG

Speaker at the April meeting was Richard Doyne, Sales Manager Plastics Division, Atlas Powder Company, and the subject was "Reinforced Molding Compounds".

He defined reinforced molding compounds as premixes in which there were many various grades. He explained that the contents of the premix consisted of resin, glass, fillers, the latter being clays and carbonates. A comparison of various properties were given of polyester premix to the thermoplastic and phenolic molding compounds. Various sample molded parts were shown to the group.

Newark

Epoxies Discussed

The Section held two concurrent sessions at its May meeting. The first session was under the chairmanship of Vincent Sussman, Epoxy Products, Inc., and covered new epoxies and trends in epoxy resin development. The other session was on the subject of plastic finishing and was under the chairmanship of Morton B. Gilbert, F. J. Stokes Corp. Subjects ranged from vacuum coating to coloring of plastics.

North Texas

Plastics in the Construction Industry

ERNEST F. DOURLET

The April 18, 1960 meeting of the North Texas Section, Society of Plastics Engineers was held at Howard Johnson's restaurant on the Dallas-Ft. Worth turnpike.

Fifty-two members were present. Thumbnail biographies were given by Glenn Grimes, Tom Harbor, and Wayne Kistler.

Bob Theobald, Dow Chemical Company, Freeport, Texas gave a very interesting program on "Plastics in the Construction Industry". He cited some of the reasons for the growth of plastics in this field: Weight reduction; simplification; lower installation costs; and longer life. He predicted that plastics used in construction would grow 60% in volume during the 1960 decade when compared to the 1950 decade. His talk was extensively illustrated by slides of different plastic applications in the construction field.

Philadelphia

Management Night

On April 26 about 75 members and guests were present for the Philadelphia Section's management night. Mr. W. T. Cruse, Executive Vice-President of SPI spoke on SPI activities aimed at advancement of the industry. Some of the major problem which the industry has faced during the past year were reviewed from the aspect of what SPI did to help the industry over these hurdles. The SPI has also been active in the development of standards for various phases of the plastics industry such as pipe and film.

The conclusion of Mr. Cruse's talk was devoted to "Trends in Plastics Around the World." A very interesting collection of slides was shown from Mr. Cruse's recent world tour. These included views ranging from the very modern Russian and West German equipment and exhibits to plastics manufacturing in India where manpower instead of machinery still plays an important role.

The Philadelphia Section was also honored to have present Mr. Frank W. Reynolds, First Vice-President of SPE and Administrator for the Professional Activity Groups. Mr. Reynolds reviewed the professional development of the SPE and the importance of the Professional Activity Groups in its future growth.

For its May meeting the Philadelphia Section was the guest of the Owens-Corning Fiberglas Corporation, Barrington, New Jersey.

Pioneer Valley

Russia

J. R. JOHNSTON

Jack Kavanaugh, Standard Tool Co., Leominster, Massachusetts, was the guest speaker and presented a very enlightening talk on his experiences in Russia, while there with the American Exposition as the sole exhibitor of injection molding machines.

His talk was of a non-technical nature, centered around 200 colored slides. Because of strict Russian censorship, pictures could only be taken of historic places and points of interest. Jack Kavanaugh's comments showed an excellent background of Russian pre-revolutionary history.

The last part of his talk was devoted to the exposition with its many sidelights and incidents.

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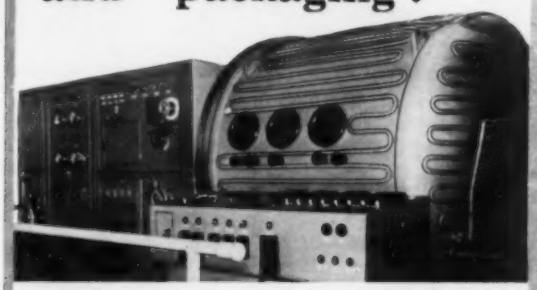

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Rochester

SPE Past President Sutro Visits Rochester Section

DAVID L. MESSENGER

The April meeting of the Rochester Section was held at the Colonial Hotel on April 11, 1960. Thirty-nine members and guests were present.

Following dinner Mr. Fred C. Sutro, Jr. of Spencer Chemical Company and past president of the National, spoke on the latest developments in polyolefins. Mr. Sutro's talk, illustrated with slides, covered the development of polyolefins from 1950 to 1959 as well as some interesting predictions for the next five years through 1965.

Southern California

Panel Discusses Polyolefins

Milton Buck of L. H. Butcher Co. was moderator of a panel which discussed polyolefins. On the panel: Frank Hughes, Dow Chemical Co. (low density polyethylene), Robert Lindegren, Du Pont (medium density polyethylene), George Sollenberger, Koppers Co. (Type III, high density polyethylene) and Paul Metzger of Hercules Powder Co. (polypropylene).

St. Louis

St. Louis Hears Gordon Thayer

RICHARD D. KOEHRMANN

Speaker for the March meeting was Gordon B. Thayer, Dow Chemical Co. His subject was "Plastic Mold Design and Construction for Today's Needs." He discussed materials for mold cavities, stress relief, hot runners, and mold temperature control.

In April, John D. Young of Du Pont addressed the group. His subject was "Automotive Plastics, Today and Tomorrow." Mr. Young discussed current commercial plastics in domestic and foreign autos, the importance of designing for plastics, plastics in auto bearings and bushings, and future opportunities for plastics in the auto industry.

Upper Midwest Section

New Extrusion Developments

CHARLES M. SMITH

Mr. Frank Nissel of the Prodex Corporation presented a very fine talk on "New Extrusion Developments" at the March 21st meeting. Areas of special interest discussed by Mr. Nissel were relationship between size and output of modern extrusion equipment, use of the extruder to plasticize polymer for the ejection molding of extremely large parts, extrusion of unplasticized vinyl, and adiabatic extruder operation.

At the April meeting, approximately 152 members and guests of the Upper Midwest Section, Society of Plastics Engineers listened to a very interesting lecture presented by Mr. William J. Gort of Koppers Co., Inc. The subject covered was "New Developments in Expandable Polystyrene" supplemented with slides.

Mr. Gort, who is technical director of Expandable Polystyrene for Koppers Co., stated that their company pioneered new industry in 1954 in polystyrene novelty items.

Trade name for Koppers expandable Polystyrene is "Dylite". Some interesting cost comparisons show that paper cost $12.00 a cubic foot, steel $25.00 a cubic foot, crystal polystyrene $14.00 a cubic foot and Dylite 40¢ a cubic foot.

ABOUT MEMBERS

Dr. Stein

Dr. Sidney J. Stein, director of research and engineering for International Resistance Co. has been elected a Vice-President. Dr. Stein has been with IRC for 11 years and was made director of research and engineering in 1958. A graduate of Brooklyn College and Polytechnic Institute of Brooklyn, he was the recipient of a silver "A" pin awarded by the Army Engineers Corps for his work from 1943 to 1946 on the Manhattan (atomic bomb) projects. Dr. Stein is a member of SPE's Publications Committee.

H. M. Harris recently joined ESB-Reeves Corp. as Manager of Market Development. The company is a joint venture of Electric Storage Battery Co. and Reeves Brothers of New York to make microporous plastics.

James H. Brodie has been appointed Sales Manager of the Reinforced Plastics Div., Fabricon Products. He will be responsible for the sales of prepreg materials. **Jack Bloch** joins Loma Industries, Inc. as director of products design and development. Mr. Bloch comes to Loma from Foster Grant Co.

William T. Cruse, Executive Vice President of SPI accepted the Silver Anvil Award on behalf of SPI from the American Public Relations Association. The award was in recognition for SPI's educational campaign conducted last fall to show the proper use of plastic bags.

James S. Hearons, Owens-Corning Fiberglas Corp., was named one of the company's 25 top salesmen. Mr. Hearons is a graduate of Notre Dame University.

Dr. Herman J. Lanson led an all-day seminar on waterproofing with resins and plastics recently. Dr. Lanson is Vice President and Technical Director of the U. S. Vehicle and Chemical Co. He also conducts a course in the Technology of Resins and Plastics at Washington University, St. Louis, in cooperation with the St. Louis Section of SPE.

◄ Mr. Tanner

Glenn A. Tanner has been appointed Director of Sales for the Plastics Div., (National Cleveland Corp.) which includes Auto-Vac Co., Auto-Blow Corp., and Plastics & Chemicals Div., all of Bridgeport, Conn.

Dr. Herman F. Mark, Director of the Polymer Research Institute at Brooklyn Polytech, and a member of SPE's Publications Committee, spoke on "Polymers of the 1960's, at the April 26th dinner-meeting of the Eastern New England Section of SPE. Dr. Mark, fourth from the left, is pictured (left to right) with **Robert Flynn,** president of Lowell Technological Institute's SPE Student Chapter, host for the meeting, **Dr. Raymond O. Normandin** of the Institute's Department of Plastics Technology, **Gim Fong,** President of the Section, **Dr. Mark, Dr. Martin J. Lydon,** President of LTI, and **Dr. Russell W. Ehlers,** head of the Institute's Plastics Department and chairman of SPE's membership subcommittee.

Mr. Foster

James L. Foster has been appointed manager, polyethylene sales of Goodrich-Gulf Chemicals, Inc. Mr. Foster was formerly with B.F. Goodrich Chemical Co. and Procter and Gamble.

Mr. Seymour

Anthony J. Scalora becomes chief of plastics research and development at Owens-Illinois Glass Co., Toledo, Ohio.

Raymond B. Seymour was presented the 5th Annual Western Plastics Award. Presentation was made by **Frederick Rea,** Editor of Western Plastics Magazine. Seymour is a professor of chemistry at Sul Ross State College, Alpine, Tex. and is president of Alcylite Plastics & Chemical Corp., Newhall, Calif. Seymour is the author of over 100 technical publications, 60 U.S. patents, and 3 books.

Mr. Holdridge

Thomas E. Holdridge has been appointed Eastern Region Sales Manager, Narmco Materials Div., Narmco Industries, Inc.

Mr. Lydecker

Gerrit V. Lydecker was recently appointed Assistant Regional Manager in the New England Region of Union Carbide Plastics Co. He is a graduate of Stevens Institute of Technology with a B.S. degree in Mechanical Engineering.

SPE members take part in press conference to kick off campaign for industry support of American Plastics Institute. Shown in picture left to right, are:

(front row) Gordon Kline, National Bureau of Standards; John W. LaBelle, Assistant to the President, Foster Grant Company; J. H. Dillon, President, Textile Research Institute; S. E. Q. Ashley, Manager, Major Appliance Laboratories, General Electric Company; A. A. Hutchings, Vice-President, F. J. Stokes Corporation; and Professor Louis Rahm, Princeton, University. (back row) Ralph L. Mondano, Manager, Plastics Plant, Raytheon Company and J. H. Du Bois, Chairman of the Board, Tech-Art Plastics Company. All but Messrs. Dillon and Ashley are SPE members. Messrs. LaBelle and DuBois are Past Presidents of SPE. The press conference, held in New York on Tuesday, April 26, outlined plans for representatives of the business and technical press.

The proposed Plastics Institute—it was explained at the conference— would be concerned with both the industry's immediate problems and the assurance of its future health and growth. Primarily, the Institute would fulfill the need for long-range basic research into the nature and characteristics of plastics materials and other significant aspects of the science and engineering of plastics, and for disseminating the findings of this research to all levels of plastics production, processing, and end-use. The Institute would also be concerned with the education—at the graduate school level—of a large number of qualified plastics engineers and chemists, who are badly needed by the industry. For this purpose, it would be established at one of this country's leading educational institutions—still to be selected.

C. Wm. Cleworth, President of the Cleworth Publishing Co., Inc., was recently appointed to membership on the International Committee of the Society of the Plastics Industry.

Carl F. Massopust has been named director of product research and development of the plastics processing division of Rexall Drug and Chemical Co. Mr. Massopust was formerly associated with General American Transportation Corp. He will reside in the Los Angeles area.

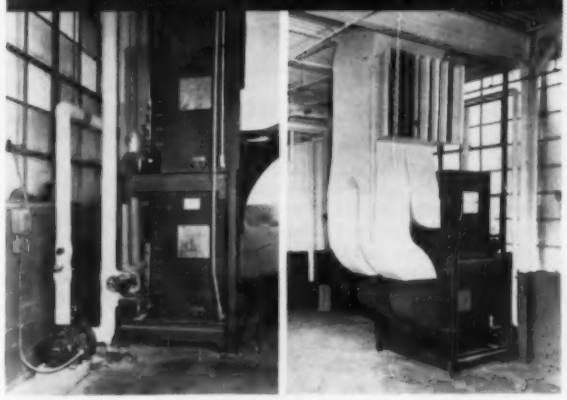
Denis J. Mullins and Frank J. Ward were promoted to the position of account manager, a new classification established by Dow Chemical to provide recognition and incentive for outstanding salesmen who are not engaged in supervisory work.

DEATHS

Robert M. McGee, 57, technical service representative for Plaskon Molding Compounds at Toledo, Ohio plant of the Plastics and Coal Chemical Division, Allied Chemical Corp., died on March 9th, after an extended illness.

Mr. C. C. Gildersleeve, 30314 Lake Road, Bay Village, Ohio, passed away very suddenly in January. He was the president of Precision Molded Plastics, Inc., in Cleveland, Ohio, and has been a member of SPE since January 5, 1945, being associated with the Cleveland Section.

MULTITEM.. THE FINEST INDUSTRIAL WATER CHILLER EQUIPMENT *That Money Can Buy!*



MULTITEM CONTROLLED CHILLING TREATMENT...

• Speeds your product to market • Trims manufacturing costs by reducing cooling lag-time • Cuts water bills • Reduces maintenance and moving costs • Saves on Fuel

The MULTITEM unit is fully air-cooled and requires no water for the refrigeration cycle. Its closed system permits 100% recovery of water for processing. You have the further unique advantage of having a built-in ventilating system for summer operations and a heating system for winter operations.

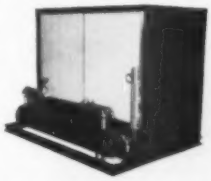
The MULTITEM is a temperature control unit designed to circulate cold water through any process that requires rapid cooling for increasing cycles of injection molding, extrusions and other types of forming operations.

The MULTITEM system improves the quality of your product and eliminates expensive maintenance caused by corrosion and lime deposits. The cost of electric energy is recovered by reducing plant heating expense during winter operation.

Application Engineering Corporation, maintains a unique cooling systems design staff to provide working drawings and specifications for your individual requirements when installing your MULTITEM heat transfer units. This department specializes in water chilling and recovery systems and their experience is available to you as an added service on any water chilling problem.

Application Engineering Corp.

3811 PODLIN DRIVE, FRANKLIN PARK, ILLINOIS, POrter 6-5653



MULTITEM Model S—A versatile, compact water recovery unitfitted for ceiling suspension—takes no valuable floor space. Model S units do not include pump and tank. Multiple units may be connected to an Application Eng. Corp. pump and tank set, if desired.

MULTITEM Model TP—The MULTITEM Model TP is a completely self-contained water chilling system suitable to a wide variety of industrial applications. It includes a water pump and water storage tank, delivered and ready to plug in after hose connections are made to process.

Employment & Service Guide

POSITIONS OPEN

DEVELOPMENT ENGINEER

NRM has an exceptional opportunity for top quality project engineers. Substantial experience in blow molding or extruder design can lead to rapid advancement. Please send resume of education, experience and salary requirement to: E. E. Heston, Manager, Extruder Division, NRMC, 47 West Exchange Street, Akron 8, Ohio.

PLASTICS BLOW MOLDING FOREMAN SUPERVISOR

Experienced on latest equipment techniques and materials. Opportunity with growth company in Metropolitan New York. State full experience and salary requirements.

CHANAL PLASTICS CORPORATION,
63-20 Austin St., Rego Park 74, New York.

SUPERVISOR

Product and Process Engineering

Position open for Mechanical Engineer with main experience in nylon injection molding and some experience in compression molding. To handle process development within the Plant and some travel and customer relations with regard to new product development. Responsible for supervision of design tooling and Quality Control. Age 30 to 45 years. Salary $12,000 to $15,000.

Box 3860, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

SALES ENGINEER

Unusual opportunity with large progressive growth minded paint and plastic mfr. to handle advanced line of corrosion resistant synthetic surface coatings. Prefer man capable of eventually supervising in his area.

Excellent salary plus bonus. All Co. benefits. Reply in confidence to Farboil, 801 Key Highway, Baltimore 30, Md.

NYLON SPECIALIST

Five or more years in molding and extruding nylon and other thermo-plastics to close tolerances. Must have formal, technical or academic background besides broad, practical production and supervisory experience. Excellent opportunity in growing southern New England organization. Reply Box No. 4860, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

SALES ENGINEER

Sales Engineer with mechanical engineering background and a thorough knowledge of compression and injection molding and tooling, to represent one of the Midwest's largest molders in the Chicago Metropolitan Area. A real opportunity for a go-getter.

Send recent snapshot with letter outlining education, experience, marital status, and salary requirements. Box 5560, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

PLASTICS APPLICATION ENGINEER

We are looking for a Chemical Engineer with 2 to 5 years experience in the application of thermoplastics.

This position offers an opportunity to join the Research and Development Division of our progressive and growing company.

Please send full details in confidence to:

Personnel Director
FOSTER GRANT CO. INC.
Leominster, Mass.

POLYMER CHEMISTS

One of America's most progressive producers of aluminum has excellent opportunities for three polymer chemists in laboratory being established for newly expanded plastics division. At present time major emphasis is being placed on polyvinyl chloride films, polyvinyl alcohol films, polypropylene and foam plastics. Two to five years experience in one or more of these areas is essential.

Educational requirements include a B.S. or M.S. in chemistry with emphasis on organic.

Salaries for these positions are open and will depend on educational background and experience. Southeast location.

Please send resume stating age, education, experience and salary requirements to:

General Employment Manager
REYNOLDS
METALS COMPANY
Richmond, Virginia

PLASTICS EQUIPMENT ENGINEERS

Fast growing design engineering organization offers outstanding opportunities for engineers familiar with specifications, layouts, operations of Extruders, Banbury's, Film, Coloring and Compounding. Experienced in Plastics, Vinyls, Polyolefins, Polystyrenes, Rubbers, etc.

All benefits including Profit Sharing Plan. Please send resume in complete confidence to Mr. L. P. Mallahan, Personnel Director.

Crawford & Russell Incorporated
7 Market Street
Stamford, Conn.

SALES REPRESENTATIVE

Nationally known custom fabricator of Fluorocarbon resins needs sales representation west of the Mississippi. Products have wide application in the mechanical, electrical and chemical fields. Established manufacturer's representative organization preferred but will consider established individual with superior qualifications. Write to Box Number 5060, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

SALE REPRESENTATIVE WANTED

Pioneer Manufacturer of

EPOXY COMPOUNDS

and

EPOXY COLOR PASTES

needs representatives to follow up large number of fine sales leads in various parts of country.

Write THE CLINTON COMPANY
1210 ELSTON AVE.
CHICAGO 22, ILLINOIS

POLYMER APPLICATIONS RESEARCH LEADER

To head SOHIO'S long range established program covering molding resins, elastomers, fibers and coating compounds. Petrochemical acrylonitrile, acrylates, olefins, and other monomers are being investigated. M.S. or Ph.D. chemist or chemical engineer preferred with at least three years' pertinent experience. Location: New laboratory in eastern suburb of Cleveland.

Write in confidence to:

THE STANDARD OIL COMPANY (OHIO)

Research Department, H. E. Alford, 4440 Warrensville Center Road, Cleveland 28, Ohio

PLASTICS DESIGNER

Tool and mold. Experienced in Vinyl and Phenolic molding. Medium size northeastern Indiana manufacturer offers exceptional opportunity in the field of electrical harness components. Give complete personal details in your reply. Box 4760, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

POSITIONS WANTED

MANUFACTURER'S AGENT

Chemical Engineer—Recently established as Manufacturer's Agent (January 1960). Ten years previous sales and technical service experience in Plastics & Resins.

Plastic molding powder sales to Refrigeration and Custom Molders. Yearly gross sales for previous employer (a Sales Agent) amounted to over $1,500,000.00

Resin sales and technical service to Plywood, Furniture and Mineral Wool—Glass Fiber industries (for same previous employer) amounted to approximately $750,000.00 gross annually.

I have industrial contacts and I desire to establish additional line for Reputable, Well-Managed, Aggressive and Growth-Minded company for the Louisville, Ky. and surrounding territory to include Indianapolis, Evansville, Cincinnati and Nashville. Box #5660, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

DEVELOPMENT ENGINEER

Young management qualified process/product development engineer with excellent experience in plastics development and production desires responsible position with progressive company. Chemical background as Technical Coordinator in extrusion compounding, coating application development and production. Box 4960, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

MANUFACTURING ENGINEER OR PRODUCT DEVELOPMENT

Young Organic Chemist with seven years experience in metallic materials and processes; 3½ years experience in current position in manufacturing engineering responsible for potting, encapsulating, casting, coating, and tooling with a variety of thermoplastic and thermosetting materials. Also involved in materials selection, testing, and vendor contacts. Desires a similar position in manufacturing engineering or product development and application. Resume sent on request. Box 5360, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

INDUSTRIAL CHEMIST

B.S. Twenty years successful and diversified experience in resins, plastics, adhesives, coatings, fire retardants, impregnation technics, paper, oil filters. Name your product—will develop or improve it. Age 42. Box 5460 SPE JOURNAL, 65 Prospect St., Stamford, Conn.

RESEARCH AND ENGINEERING DIRECTOR

Executive with excellent 19-year record in planning, organizing, and administering research and engineering programs. Has developed effective teams which have contributed greatly to corporate growth and expansion. Originator several patented items and processes. Seeks position with challenge, responsibility, and growth potential. B.S. and M.S. in chemistry, age 48, married, presently employed. Reply Box 5160 SPE JOURNAL, 65 Prospect St., Stamford, Conn.

20 YEARS EXPERIENCE

Over twenty years experience in the plastics, rubber and chemical industries. Activities have included research, sales and technical service management with a major resin producer, followed by ten years as general manager of a vinyl coating plant. Former national officer of SPE plus committee activities in SPI. Foreign contacts. M.S. degree in chemistry. Willing to travel. Minimum salary $15,000. Box 5260, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

PLASTICS ENGINEER-ADMINISTRATOR

Over ten years experience in plastics. Last five in R & D administration. Considerable experience in extrusion, particularly in polyolefins but also with most other plastics. Have good knowledge of injection molding, blow molding, calendering, laminating, embossing, heat sealing and film orientation. Have worked on process development of both thermoplastics and thermosets, also on rheological studies of many materials. Some knowledge of market research.

Desire responsible position with good future. No geographical limitations. Box 4560, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

PROCESS ENGINEER

Young plastics engineer with eight years of extensive work in the wire and cable industry. Thorough knowledge of thermoplastics extrusion. Desires responsible position in a progressive company. Resume sent upon request. Reply Box 5760, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

POSITIONS WANTED

PLASTICS ENGINEER

M.E. Grad, 35. Specialist in compression and transfer molding, well-versed injection too. Nine years mold and product design, production, and sales-liaison experience with custom-molders; one year technical-service experience with material supplier. Seeks challenging position with progressive company where talents may be fully utilized. Box 4660, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

MANUFACTURER'S REPRESENTATIVE NEW ENGLAND

Seeking molding and extrusion lines. Covering all six New England States, calling on O.E.M. and industrial distributors. Technical knowledge of all thermosets and thermoplastics. Years of experience selling industrial plastics. Excellent sales record, complete knowledge of market. List materials processed, methods and if custom or standard products. Reply Box 4360, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

PLANT MANAGER

Age 39. Capable of assuming full responsibility for operation of your injection molding plant. Have managed 15-machine plant and coordinated sales program. Strong tooling & engineering background with 20 years actual experience. Completely familiar with molding and decorating on all thermoplastics. Willing to relocate. Resume available. Box 4460, SPE JOURNAL, 65 Prospect St., Stamford, Conn.

FOREIGN REPRESENTATIVE

American plastics manufacturing concerns interested in being represented to molders and importers in Pakistan, please contact: S. M. T. Hussain, c/o S. M. Yaquib, P.I.S., Dy Collector, Canals, 3—Canal Office Rd., Lyallpur, Pakistan.

CLASSIFIED RATES

"Position Open" and "Position Wanted"—Minimum charge: $7.00; per word. $0.25. SPE members in good standing are entitled to a total of three no-charge "Position Wanted" advertisements during any twelve month period, each ad not to exceed 50 words.

"Machinery, Equipment, Materials and Services"—Minimum charge: $15.00; per word: $0.50.

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Last day for inserting ads is the first day of the month preceding date of publication.

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FROM MISSILES TO MISSILES...

GERING Thermoplastic MOLDING COMPOUNDS

quality formulated to perform as required!

Roaring down the Atlantic test range or blasting off from the living room floor, true missile performance depends on the accurate behavior of individual components. That's where Gering's expert ability to formulate superior thermoplastic Molding Compounds comes in. Whether the end use is a vinyl jacketing compound that helps trigger a giant ICBM into space or an impact styrene toy replica, quality Gering Molding Compounds perform to perfection. Extensive laboratory and production facilities enable Gering to produce to your most exacting specifications — including flame-retardant, non-toxic, semi-conductive and other special formulations. And with these complete facilities at your service, your most demanding custom compounding requirements can always be met. Tell us your specific needs. We'll be happy to submit a recommendation at no obligation. Write today for information.

• Polyethylene • Vinyl • Styrene • Impact Styrene
• Acetate • Nylon • Acrylic • Styrene Copolymer • Butyrate

Cable Address: GERING • TWX Cranford, N.J. 137 • Sales Offices: 5143 Diversey Ave., Chicago 39, Ill.
1115 Larchwood Rd., Mansfield, Ohio • 103 Holden St., Holden, Mass.

GERING
PLASTICS
division of STUDEBAKER-PACKARD CORP.
Kenilworth, N.J.

COMPARE ... ADMEX 770 against other polymeric plasticizers—in these 4 significant tests!

RUBBER MIGRATION

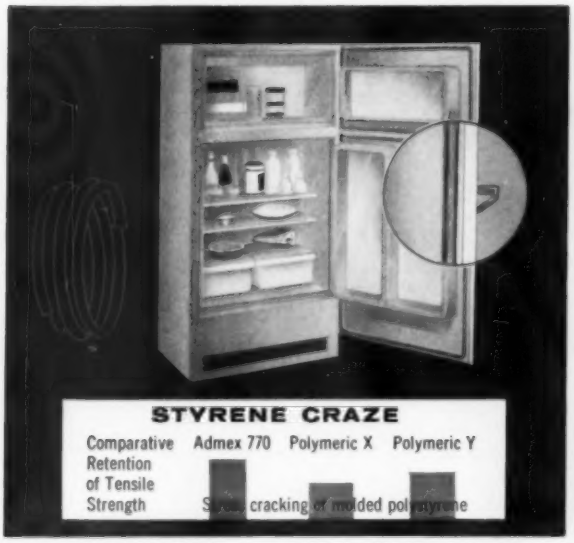
	Admex 770	Polymeric X	Polymeric Y
Neoprene	0.6	2.67	1.06
GRS	0.23	2.01	1.22

VINYL-RUBBER CONTACT frequently solves many industry problems. Admex 770 shows the highest resistance to migration into rubber products used for electrical cables, floor mats, shoe liners and rubber-based adhesives.

SOAP EXTRACTION

	Admex 77	Polymeric X	Polymeric Y
200F (24 hrs.)	3.48	4.99	3.41
140F (24 hrs.)	1.64	3.65	3.03
Cycling 140F (3 hrs.)	1.27	2.79	2.11

ADMEX 770 insures long-term flexibility in vinyl products subjected to soapy water contact, either by static or cycling exposure. Try Admex 770 in floor and wall covering, in supported and unsupported sheet, in many organosol and plastisol applications.

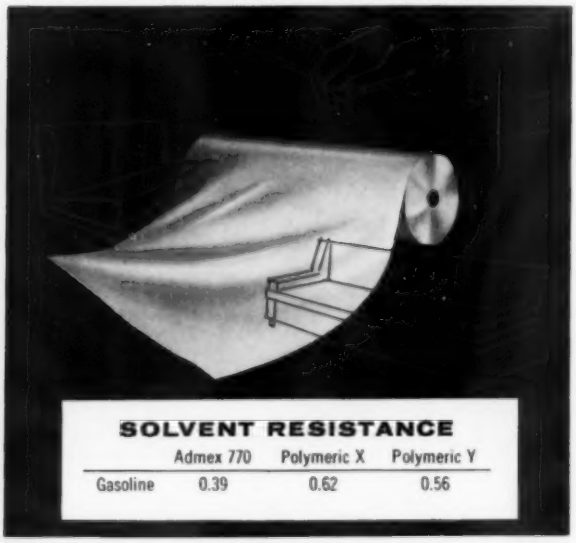


STYRENE CRAZE

Comparative Retention of Tensile Strength	Admex 770	Polymeric X	Polymeric Y

Styrene cracking of molded polystyrene

REFRIGERATOR GASKETS compounded with Admex 770 show improved resistance to crazing and marring of polystyrene. Excellent blending and extrudability, plus low odor level, make this polymeric an ideal choice for high quality profiles.



SOLVENT RESISTANCE

	Admex 770	Polymeric X	Polymeric Y
Gasoline	0.39	0.62	0.56

DO YOUR upholstery, film and sheet specifications call for high solvent resistance? Admex 770 proves superior to many costlier polymerics in its resistance to extraction by fuel and cleaning type solvents.

For data and samples, write today:

Admex
Vinyl-Plasticizers

ADM PRODUCTS: **Linseed, Soybean and Marine Oils, Synthetic and Natural Resins, Fatty Acids and Alcohols, Vinyl Plasticizers, Hydrogenated Glycerides, Sperm Oil, Foundry Binders, Bentonite, Industrial Cereal, Vegetable Proteins, Wheat Flour, Dehydrated Alfalfa, Livestock and Poultry Feeds.**

Archer-Daniels-Midland

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